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THE

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CO-OPERATION IN EXPORT TRADE.

IN view of all that has appeared in our pages during the past few years regarding the need for co-operative action on the part of British electrical and engineering firms desiring to secure export trade after the war, peculiar interest attaches to what is known as the Webb Bill that is shortly to come before the U.S. Senate. The purpose for which the Bill is designed is to authorise American exporters to co-operate in order to place themselves on an equality with foreign rivals. According to the American electrical Press, the Webb Bill has received the approval of organisations and individuals representing all elements of manufacturing, merchandising, national production, transportation, and finance in foreign trade. The National Foreign Trade Council, in placing its views before a Senate Committee, has stated that even before the war doubt as to the application of the anti-trust laws compelled American exporters individually to cope with Government-encouraged combinations of foreign rivals united to resist American competition, and often to sell to combinations of foreign buyers equipped to depress the prices of American goods. The revelations and almost certain consequences of the war, however, have left no room for doubt in the mind of the National Council that co-operation in export selling, with every safeguard against illegal restraint of domestic trade, is imperative to meet proposed *post bellum* co-operative buying, not only by groups of European industries, but even by Governments, with the object of controlling prices. It is considered that unless the Webb Bill is passed, and the legality of export co-operation established, many industries of moderate size will be unable to enter foreign trade because of prohibitive expense which co-operative effort would reduce; also that "greater stability of export business could be obtained through co-operation and a wider distribution obtained in the benefits of oversea sales as a balance wheel against recurring periods of domestic depression and unemployment."

Whatever doubt there may be in the minds of American traders concerning their right to co-operate, there need be none in the minds of British traders. These know only too well under what a serious handicap they have been placed in many British Colonial and foreign markets when their divided forces have had to meet the consolidated Trust forces of Teutonic manufacturing and finance. They know what they ought to do, and they have the power to do it. American doubts in regard to the legal rights of co-operation are stated to have

amounted to prohibition, and the consequent individualistic weakness of small concerns is described as enabling foreign buyers to play off American producers one against another, and to buy American raw materials cheaper than American consumers can, and in the long run confer upon the foreigner "a practical subsidy against ourselves."

The *Electrical World*, in a recent article, states that the American General Electric and Westinghouse Companies would experience little, if any, inferiority, as compared with their foreign competitors, so far as industrial combinations affect their efficiency, but, the writer adds, apparently in reference to the smaller manufacturer: "Co-operation of American electrical manufacturers would permit the joint financing of many foreign enterprises in which such financing must be done to secure business. Moreover, it would permit the extension of credits, where necessary, to compete with the credits offered by foreign manufacturers." Further: "In seeking the removal of restrictions or obstacles to freer trade in American goods, in propaganda favouring the adoption of American standards and designs by Governments and others, and in education abroad touching the merits of American electrical products, united action would be invaluable."

Whether the Webb Bill will pass at the present stage or not may be uncertain in view of the other more immediately important matters which, due to the enemy's ruthlessness in submarine warfare, are now engrossing the attention of the whole American people. And whether it passes now, or later, or not at all, really is a matter of domestic concern for the States alone, the present movement being intended to secure a revision of American anti-trust laws. But the moral of it all is unaffected by the issue. Our trans-Atlantic cousins have not had the same reasons as ourselves in the past for feeling the handicaps imposed in the world markets by the methods, measures, and strength of Teutonic organisation. We were awake to the circumstances of the situation, but did not in peace time see the necessity, or possess the right spirit, for adopting suitable counter-measures. War-time, which has altered the whole outlook in regard to world trade, should engender strong co-operative action on the part of British traders.

The mere recital above of the appreciation that America is now expressing of the principle of co-operation should strengthen the hands of those who have already adopted that principle as a theory for future application, as well as of those who have definitely launched their schemes.

National Service and War Loan.

As we write, the whole of the nation is passing through another of those periods of heart-searching and self-examination of which there have been many during the past two or three years. Men, munitions, and money have all been called for again and again, and the demands of the Allied cause have been successively met. To-day, the speeding-up policy is making its new demands, and these, likewise, will be met, we trust, in time to make Victory certain before the "falling of the leaves." The call for fighting men does not need to be expressed in the same way as formerly, as the Military Service Acts embrace the required numbers of men of the right age and physical strength and endurance that the conditions of modern warfare demand. But those Acts can only produce them as they are drawn from the making of munitions and from establishments engaged in industry. Therefore, the National Service scheme of Mr. Neville Chamberlain is getting to work to find substitutes for the fighting men who are still busy at the bench. At present, the call is for volunteers —every man between the years of 18 and 61 is appealed to—who are prepared to place themselves at the disposal of the State in her time of need.

Everybody who has the interests of the Allied cause at heart will wish complete success to this immense test of the voluntary industrial principle. Mr. Chamberlain is a business man who, while knowing from the inner counsels of the Government what the exact needs of the situation are, also fully appreciates how sweeping are the demands that he has been called upon to make. Apparently it will be necessary for some industries to be pooled, and for others to remain in a state of suspense, but Mr. Chamberlain has shown quite plainly that he recognises how delicate an operation these measures entail, and he is fully alive to the danger and difficulty of saying what are and what are not essential war-time industries. Economic interests and the need for exercising care so that industries shall not be disorganised more than is imperatively necessary, as they must be ready for full-speed activity immediately after the war, are present to his mind as he issues his appeal for men for the war factories. But while due weight will be given to all such considerations, the situation demands Labour of many kinds, and that immediately. Here is one of the outstanding reasons for self-examination and heart-searching, and every reader must in justice to the Cause consider his ways.

Another call for introspection is made in connection with the great War Loan, for which the lists close to-day. As Mr. Bonar Law has stated, "It is vital that the War Loan should be a success; it will be taken as the standard of the staying power of our people." It is also most attractive as an investment, to every class of the community, and there still remain a few hours. In this matter we can only secure the full measure of success if every man and woman recognises individual responsibility. Though the lists of what, it is hoped, will be the last War Loan, are closing, there will still remain ways in which industry can help. We would repeat our own appeal of several months ago to heads of industries represented by this journal to continue to push war-savings schemes among their employés as energetically and generously as they possibly can. Representing as they do what are, perhaps, more than all others, essential war industries, they are giving profitable employment to greatly increased numbers of workpeople, and from the earnings of these many more millions sterling should be forthcoming for War Loan purposes. Many electrical and engineering works are doing admirably with such schemes. It is not too late for others to follow suit.

THE INSPECTION OF MUNITIONS.

"Some New Methods, and Some Old Ones."

By "COMMERCIAL."

During the past two years the long-suffering British public has been subject, among other necessary evils, to a flood of advice, reproach, and argument, poured forth from the presses of every sort of paper in the country. So diffuse and all-embracing has this flood been, so diverse the topics, even when, as in some cases, coming from one pen, that the ordinary citizen may be pardoned for presuming that the flood had done its work. England is undoubtedly awake, and things are moving! Granted that we have gone far to abolish the old order of muddle and unpreparedness, we have good reason to believe that there still exist several hindrances to the business-like conduct of our present task. Just as the country has been plagued by the presence of the amateur lawyer touch in its great Departments of State, so it is to-day by the business amateurs in the new War Departments. Of which more anon. The hide-bound, short-sighted policy of past years of which we have in the Review complained again and again, still thrives in business, in spite of all advice, reproach, or argument.

The new war organisation has brought into being a number of new departments. There is a Director of this, that, and the other—Aircraft, Waterways, Ordnance, Navy Contracts, and so on, *ad libitum*. Each one is in the market for necessary materials, and each one has its own inspectors. The writer happens to deal with electric wires and cables, and hopes to be believed when stating that most of the said inspectors did not, prior to the war, know a cable from a cow. Some are men enough to admit it; the others show it unconsciously. Travelling expenses in the shape of train fares or motor-car expense are incurred to bring such inspectors to contractors' works, when often the job is so small as to be hardly worth while, and, in any case, the old Army or Navy inspectors could deal with the whole of such orders. One day recently two army officers came by car a 30-mile each way journey to inspect three coils of 7/22 ordinary wire. Another gentleman made the same trip by train to see 200 ft. of motor-car ignition wire. Fancy ordering such material for the British War Department in 200-ft. lots!

Numerous well-appointed London hotels are now in the hands of the Ministry of Munitions, and this is the sort of thing for which they are used. After the three coils of 7/22 before mentioned had been inspected, we received 24 foolscap size printed sheets from the Statistical Department of the Ministry, and a request that we should make a weekly return, in triplicate, of the progress of this order. The only conclusion possible is that the particular star of the Statistical Department had no idea of the nature or quantity of the material with which he was dealing, and what use he could make of a weekly return can only be conjectured.

Certain other orders necessitated the use of large quantities of raw material. This was obtained from three firms in weekly deliveries. The Ministry took this supply under their wing, and, week after week, a return was made of the quantities received. No interruption in the supply occurred, and no such weekly return was necessary. An ordinary business man would have asked us to report only when the supply failed, but they are not of this class at the London headquarters of the Ministry of Munitions. The whole thing is a waste of paper, stamps, and busy men's time.

In the average factory in peace times the question of delivery is one which looms large in the troubles of the manufacturer. To-day the same problem is a hundredfold more difficult, and quite as much so is it in a cable factory as in any other controlled works. Materials like copper and steel (wire or tape) cannot be used for any save Class A or B, and most others are not easy to obtain. Pressure of work compels the maker to quote long deliveries, and the quoted time is even then often insufficiently long. A motor-car firm is quoted five to six weeks for a quantity of ignition wire. The order comes along, and a request for part delivery at once follows in a few days. Again and again they ask for delivery, only to be refused. A new powder factory is in building, and the engines, pumps, and fittings are ready. The necessary cable is ordered, and four days later they require it, as the engines are ready, &c. A shipbuilder orders cables, and in the same way asks for immediate delivery, as the ship is urgently required and the job will be stopped.

All these are actual cases of fact. The writer is not discussing the nature of the ground in the Balkans, or the next move of the Huns. These cases are British procedure in business to-day. The Germans will never be gentlemen, and the British will always be fools. It may be pointed out that, apart from all question of the negligence and incapacity of people who habitually muddle along in this manner, it is unfair to attempt to accede to their requests for quick delivery, because it necessitates delay with the orders of others, who have been good and reasonable enough to anticipate their requirements in a proper manner. A breakdown job is in quite another category, and will always command assistance; but cases of the sort quoted are unreasonable and foolish, and the only cure lies in the hands of the people concerned. They may learn sense some day, but apparently the present upheaval has not taught them a great deal. A motor-car, an aeroplane, or a ship cannot be built in a day, even though we may be persuaded that they can. The exercise of a little intelligent foresight would obviate all such trouble, besides saving time and money spent on useless appeals for special treatment. Business people who lack that requisite are a nuisance in ordinary times. In the present instance all the goods concerned are, it should be remembered, for war purposes, and so the more need for everything to be done to avoid delay. Happily, the number of firms who are open to the charge thus made, is not apparently a large one, though they are not on that account any less conspicuous. As an alternative to the perusal by the Statistical Department of so many hundred silly forms per week, the writer suggests that they invite controlled firms to communicate when they are troubled by impossible demands from people who have not yet lost the habit of being "too late." A little attention from headquarters would possibly affect the culprits more than mere paper entreaty, and would certainly help us on with the war better than a whole car-load of triplicate advices.

STEAM TURBINES FOR LAND PURPOSES.

By H. L. GUY, A.M.I.Mech.E., Assoc.M.I.C.E.

(*Abstract of paper read before the* Manchester Association of Engineers.)

(*Concluded from page* 147.)

A 6,000-kw., 1,500-r.p.m. set, installed at the Port Dundas station of the Glasgow Corporation, illustrates the reliability of a modern steam turbine unit, and of the importance of coal consumption. The turbine is of the Rateau impulse type, designed for 190 lb./sq. in. g., and 166 deg. F. suppt., containing a velocity wheel, followed by 10 Rateau impulse stages, the maximum tip speed being 553 ft. per second.

Between July 24th, 1914, and October 31st, 1915, this set generated 52,852,500 units, or 78.93 per cent. of the maximum possible full-load output. The set was started up in February, 1914, and had generated 100,000,000 units by August, 1916, so that with a coal consumption of, say, 1.75 lb. per kw.-hour, the coal used by the set would equal 78,250 tons in two and a half years, or at the rate of 31,300 tons per annum, which represents a coal bill of £23,500 per annum, with coal at 15s. per ton, so that each 1 lb. improvement in steam consumption saves about £1,710 per annum in cost of fuel alone.

In the example stated, if the saving in coal consumption alone is considered, and capitalised at the rate of 10 per cent., an increase in purchase price of £2,350 would be justified for each 1 per cent. improvement in steam consumption.

A set supplied to the London County Council, rotating at 1,500 r.p.m., and rated at a normal load of 8,000 kw., and a maximum capacity of 10,000 kw., of the British Westinghouse Rateau impulse type, was designed for a pressure of 180 lb./sq. in. g., with steam at a total temperature of 550 deg. F.; it contained a two-row velocity wheel, followed by 12 Rateau stages, the first Rateau blade height being 1 7/16 in., and the last 14 in., so that the ratio of the last blade height to the mean diameter is just over 1 to 5, and the maximum tip speed 565 ft. per second. The overall length of the set is 37 ft. 2 in., and the maximum width 12 ft. 7 in., so that

21.4 KW. capacity is provided per sq. ft. of floor space at the maximum rating.

A condenser, having 20,000 sq. ft. surface, maintains a vacuum of 28¼ in. (30 in. bar.) at maximum load.

The following official test consumptions were obtained, the figures being corrected to 180 lb./sq. in. g., 550 deg. F.

Load.	125 %	100 %	75 %	50 %
Vac. inches (30-in. bar.) ...	28½	28½	28·82	28·95
Adia. heat drop, B.TH.U./lb. ...	385	385	396	402·2
Steam consump., lb./KW.-hr.	12·208	12·453	12·598	12·809
Generator efficiency ..... %	96	95·5	94·5	92·5
Adia. turbine efficiency %	75·4	74·4	72·2	71·4

One of the first sets of 15,000-KW. capacity, built by Messrs. J. Howden & Co., was installed in the Stuart Street power station of the Manchester Corporation. The turbine is of the Zoelly impulse type, containing 14 stages.

The condensing plant was supplied by Messrs. Richardsons, Westgarth. The surface condenser has a surface of 24,000 sq. ft. The following are the guaranteed steam consumptions:—Steam conditions: 190 lb./sq. in. g., 530 deg. F. total temp., 27.5 in. vac., adiabatic heat drop 357.4 B.TH.U./lb.

Load.	125 %	4/4	3/4	1/2	1/4
Steam consumption, lb./KW.-hr.	14·25	13·65	14·12	14·92	16·95
Combined genr. and turbine efficiency	66·7	69.5	67·2	63·6	56·0
Assumed generator efficiency...	96·0	95·0	94·5	93·0	87·5
Corresponding turbine efficiency	69·5	72·9	71·1	68·5	64·0

For examples of high-pressure turbines of the largest size, we have to turn to the United States of America. The British market in the past has not demanded units of similar capacity, but when such sets are required British makers will be found able to cope with the demand in the fullest measure.

One of the most notable American large sets is that shipped in 1913, by Messrs. C. A. Parsons, for the Fisk Street station of the Commonwealth Edison Co. The plant is rated at 25,000 KW. at .95 P.F., and runs at 750 R.P.M., the generator being 25 cycles, 3-phase. The following consumptions were guaranteed:—Steam conditions: 200 lb./sq. in. g., 200 deg. F. superheat, 29 in. vac., adiabatic heat drop 418.5 B.TH.U./lb.

Load.	25,000 KW.	20,000 KW.	10,000 KW.
Steam consumption, lb./KW.-hr. ...	11·65	11·25	12·5
Combined turbine and genr. efficiency	69·8	72·3	65·0
Assumed generator efficiency	96·0	95·0	92·0
Corresponding turbine efficiency ...	72·7	76·1	70·7

The high-pressure blading consists of 64 rows, arranged in six expansions. The first blade is 2¾ in., and the last 6½ in. long.

The low-pressure cylinder is built on the double-flow principle, each flow containing 24 rows of blades, arranged in six expansions, the first blade height being 2¾ in., and the last 19 in., the ratio of the blade length to mean diameter is approximately 1 to 5.6, while the tip speed of the last row is 410 ft. per second. The exhaust is 252 sq. ft. in area, which at 25,000 KW., corresponds to an exhaust velocity of 190 ft. per second.

The condenser has a surface of 39,300 sq. ft. The set is 76 ft. 2 in. long, and 18 ft. at the widest point; the capacity per sq. ft. of floor space is therefore 18¼ KW. at maximum.

The General Electric Co. of America supplied for the Northwest station of the Commonwealth Edison Co., of Chicago, a set rated at 30,000 KW. at 1,500 R.P.M., the alternator being of the 3-phase, 25-cycle type, generating at 2,000 volts. The turbine is designed for 230 lb./sq. in., 600 deg. F. total temperature, and 29 in. vacuum.

The turbine consists of a high-pressure and low-pressure cylinder placed in tandem, the high-pressure cylinder containing a two-row velocity wheel with an approximate mean diameter of 7 ft. 6 in., followed by nine single-row impulse wheels, which expand the steam down to 7 lb./sq. in. absolute, at which pressure it enters a two-stage double-flow low-pressure turbine, having wheels of an approximate mean diameter of 9 ft. 9 in. A rectangular exhaust area of 168 sq. ft. connects the turbine to the condenser. The ratio of the length of the last blade to the mean diameter is approximately 1 to 7.8, and the tip speed 860 ft. per second. The surface condenser has 50,000 sq. ft. of cooling surface.

This turbo-generator is 59 ft. 6 in. long by 18 ft. 4 in. wide, so that a capacity of 27.5 KW. is provided per sq. ft. of floor space.

A set of the same rating and speed by the same maker weighs 435 tons, or 32.5 lb. per KW. The consumption guarantees of this set are as follows:—Steam conditions: 215 lb./sq. in. g., 200 deg. F. superheat, 28¼ in. vac., adiabatic heat drop 403 B.TH.U./lb.

Load.	30,000 KW.	22,500 KW.	15,000 KW.
Consumption, lb./KW.-hour	12·45	11·9	12·75
Combined turbine and genr. efficiency	67·8	71·0	66·2
Assumed generator efficiency ...	96·0	95·0	93·0
Corresponding turbine efficiency ...	70·6	74·8	71·4

The American Westinghouse Co. supplied a 30,000-KW. set to the Interborough Rapid Transit Co., which was started up in December, 1914. In 1901 four 7,000-KW. Allis Chalmers reciprocating sets were installed, having a steam consumption of 17.3 lb./KW.-hour. These engines have now been replaced by three turbines with a total capacity of 90,000 KW., occupying the same floor space as the original engines. The purchase price of the turbine sets per kilowatt was only 22.5 per cent. of that of the engine set, while the saving in coal cost alone on one set is estimated as being over £40,000 per annum. Since the installation of the first set the average monthly coal consumption has been reduced from 2.5 to 1.5 lb. per KW.-hour.

The steam end of the plant consists of a high-pressure and separate low-pressure turbine, each coupled to its own alternator, but permanently connected on the electrical side, the high-pressure turbine running at 1,500 R.P.M., and the low-pressure at 750 R.P.M.

Steam entering the high-pressure turbine at a pressure of 200 lb./sq. in., with 120 deg. F. superheat, is expanded in six expansions to a pressure of 14 lb./sq. in. absolute, when the most economical load of 25,000 KW. is carried. The height of the first blade is 4 in., the last being 9 in. Cast steel is used for the high-pressure cylinder.

Each side of the double-flow low-pressure cylinder contains 20 rows of blades, arranged in six expansions, the first being 6 in. and the last 18 in. high, rotating with a mean peripheral speed of 400 ft. per second, so that the ratio of the length of the last blade to its mean diameter is 1 to 6.75. This low-pressure cylinder weighs 147 tons, while the weight of the low-pressure rotor is 57 tons. The area of the exhaust is 190 sq. ft. In the rotors the stress in the drums and disks at full speed is less than 4.3 tons per sq. in., so that ordinary materials can be used in their construction.

After passing through the low-pressure cylinder the steam passes into two surface condensers, each having 25,000 sq. ft. of surface, which maintain a vacuum of 29 in. when supplied with 37,500 gallons cooling water per minute.

Test results are shown below. Steam consumptions are corrected to 215 lb./sq. in. absolute, 120 deg. F., 29 in vacuum (30 in. bar.), corresponding to an adiabatic heat drop of 399.9 B.TH.U./lb.

Load in KW.	32,348.	26,740.	26,505.	21,925.	16,342.
Corrected consumption, lb./KW.-hour	11·332	11·258	11·274	11·421	11·770
Assumed genr. efficiency	96·0	95·0	95·0	94·3	94·0
Turbine efficiency relative to adiabatic expansion	78·25	79·6	79·5	79·0	77·9

Geared Turbines.

The geared turbine has now established a place for itself as an important prime mover for various land purposes, in all those cases where the most suitable speed of the driven machine is less than half the best speed of the turbine. One application is the use of gears for driving a direct-current generator. In such a case there are three alternatives deserving consideration:—

(*a*) The turbine may be direct coupled to a high-speed D.C. generator, running at a speed of 2,500 to 3,000 R.P.M. The difficulty with such a machine lies in the construction of a satisfactory commutator, and in spite of the fact that some ingenious devices have been developed to overcome these difficulties, such as the radial commutator, a 500-KW. set in a single machine appears to be the limit for safe operation. For outputs below that stated, when the voltage is suitable, this type of plant is cheaper, as efficient, and occupies less space than either of the alternatives.

(*b*) A turbo-alternator, running at 3,000 or 3,600 R.P.M., can be used in conjunction with a rotary converter, forming a combination which, in certain cases, has distinct advantages. This combination is particularly suitable when D.C. power must be supplied to several points some distance apart, when the transmission losses and cost of mains can be kept to a minimum by generating at a moderate or high voltage, and transforming down at the sub-station where the rotaries are installed. In many instances direct current is essential for a part of the system only, while the remainder can be served more efficiently by an alternating supply, a case for which the rotary plant is peculiarly suitable. With such a mixed system of distribution the rotary has the further advantage that it can be run inverted, taking direct current from sets with which it works in parallel, or from a battery, and supplying alternating current into the mains, thus helping out the A.C. sets in case of a breakdown.

A further advantage will arise if the linking-up schemes now under consideration mature, because small D.C. stations will receive alternating current from the trunk mains and convert it into D.C. by means of an existing rotary, thus having their main turbo-alternator sets as a stand-by, whereas in the case of the direct-connected or of the geared D.C. generator, it will be necessary to install rotaries. The turbo-alternator rotary plant does not suffer from the limitation in desirable size, which applies to the other two alternatives.

(*c*) Double-helical turbine gearing can be employed to reduce the speed of the turbine to that most suitable for an engine-type D.C. generator; the speed of the former is usually between 3,000 and 4,000 R.P.M. for units of moderate size.

The relative merits of the two latter alternatives are shown in figs. 4 and 5. The costs of the two types of plant are plotted in fig. 4, as ordinates, the output being abscisse.

At 1,500 KW. the purchase price of the two types is the same; for larger outputs, the rotary scheme is the cheaper.

The steam consumptions for the two types have been plotted in fig. 5, showing that the rotary plant has a consumption at full load from 3.8 per cent. to 1.8 per cent.

higher than the geared combination, a saving in favour of the geared scheme which, for sizes above 1,500 KW., is more than balanced by the lower purchase price of the rotary set.

One of the largest geared D.C. sets was supplied to the Cleveland Electric Illuminating Co., Ohio, in 1912. The turbine, which is of the back-pressure type, exhausting at atmospheric pressure, running at 1,800 R.P.M., is coupled to a 3,750-KW. generator through a double-helical gear of the Melville-Macalpine type. The following particulars of these gears may be of interest:—

Maximum B.H.P.	5,500
Speed pinion, R.P.M.	1,800
Speed wheel, R.P.M.	180
Pinion pitch diameter	10·392 in.
Wheel pitch diameter	103·43 in.
Number of teeth on pinion	26
Circ. pitch teeth	1,255
Length tooth face	40 in.
Vel. at pitch circle, ft.-sec.	81·61
Lb. pressure per in., face width ...	92·68
Number of pinion bearings	3
Angle of helix	30 deg.

When alternators are required of moderate or small output for 25 cycles, the alternator can, with advantage, be driven by a geared turbine, because, with 1,500 R.P.M., the turbine speed which is the highest possible for direct-coupled sets, the plant becomes both expensive and inefficient, as is clearly shown in fig. 1. The possibilities of this solution can be illustrated by the following example:—

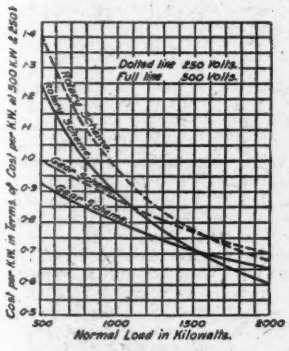

FIG. 14.—RELATIVE COSTS OF GEARED AND ROTARY DIRECT-CURRENT SETS.

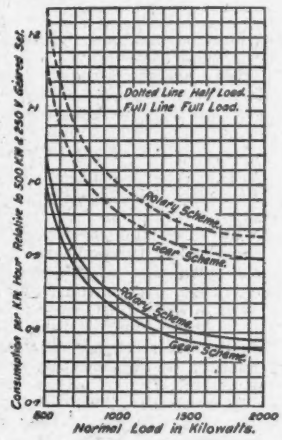

FIG. 5.—RELATIVE STEAM CONSUMPTIONS OF GEARED AND ROTARY DIRECT-CURRENT SETS.

A Manchester firm was faced with this difficulty in a recent extension to its power house. A set normally rated at 1,500 KW. was required to supply a three-phase, 440-volt, 25-cycle system. These requirements could be met by either of the following alternatives:—

Scheme A.—A 1,500-R.P.M. turbine, directly coupled to an alternator.

Scheme B.—A 3,750-R.P.M. turbine geared to an alternator running at 750 R.P.M.

Scheme C.—A 3,600-R.P.M. turbine geared to an alternator running at 500 R.P.M.

Scheme D.—A 3,000-R.P.M. turbine directly coupled to a 50-period alternator, and electrically coupled to a 50-period motor, driving a 25-period alternator.

The relative steam consumptions and costs of these schemes are shown in the following table:—

Scheme	A	B	C	D
Steam consumption:				
Full load ...	1·0	0·927	0·935	1·0
Half load ...	1·0	0·922	0·93	1·05
Cost	1·0	1·005	1·11	1·38

Scheme B was adopted, a turbine having one velocity stage and seven Rateau stages being coupled to a Melville-Macalpine floating frame gear, driving a three-phase, 25-period alternator.

Many engineers insist on having condenser pumps steam driven, and as all the pumps are usually designed on the rotary principle, a steam turbine is very suitable for this purpose. Unfortunately, a high-speed low-lift centrifugal pump, running at 2,500 R.P.M., is usually 30 to 40 per cent. less efficient than one built for 500 R.P.M. To overcome this difficulty a reduction gear can be introduced between the turbine and the centrifugal pump, the air and extraction pumps being directly coupled to the turbine. Such a set, supplied to the Birmingham Corporation, and working in conjunction with a 5,000-KW. set, is shown in fig. 6. The air and extraction pumps take 57 B.H.P., while the circulating pump requires 133 B.H.P. to drive it. In this particular case the geared scheme requires 39 per cent. less steam than one originally proposed, in which the circulating pump was directly coupled to the turbine and run at 2,500 R.P.M.

REDUCING TURBINES.

In a large number of industrial concerns, such as textile and dyeing works, chemical works, sugar factories, paper mills, breweries, &c., a supply of heating-steam is necessary for sundry heating, boiling, and drying processes, and at the same time the plant requires a considerable amount of power. By generating the heating-steam at 150 to 250 lb. per sq. in., and passing it through a back-pressure or reducing turbine before it is exhausted to the heating main, a considerable amount of electrical power can be generated for a small additional expenditure of coal, usually less than half a pound per kilowatt-hour.

The steam required for heating large buildings may be utilised to generate electrical power, and if central heating stations are ever introduced into this country on a large scale, the electrical energy which can be generated will represent a valuable by-product.

With the back-pressure turbine the amount of steam required for heating purposes, and the work which can be done by the turbine, are directly connected. In many installations the amount of electrical power required and the demand for heating-steam bear no direct relation to one another, so that a machine is desirable which will give either heating steam or electrical power independently, as the demand for either varies. To meet these requirements the reducing turbine was introduced, consisting of a back-pressure turbine, followed by a low-pressure turbine on the same shaft, and in the same casing. Steam from the high-pressure main, at some pressure usually between 150 and 220 lb. per sq. in. g., with a superheat from zero to 300 deg. F., passes through the stop valve and high-pressure governor valve into a steam belt, feeding the nozzles of the first stage. It then passes through a velocity wheel and a Rateau stage before being exhausted at some pressure between 60 lb. per sq. in. g. and atmospheric, into the heating main *vid* a non-return valve and a stop valve.

If the work done in the high-pressure stages is less than the load on the generator, a certain amount of steam is by-passed by an automatic valve through the Rateau stages in the low-pressure end, and expanded down to the vacuum in the condenser. A variation of 5 per cent. in steam pressure up or down is a reasonable range within which the automatic by-pass valve should maintain the heating-steam pressure.

If at any time the amount of heating-steam required exceeds that corresponding to the load on the generator, the deficit is supplied by a reducing valve. The non-return valve is provided to prevent steam from the reducing valve, or from another set, passing through the heating main into the low-pressure end of the turbine, when it would not be under the control of the governor, and might cause the machine to run away. An atmospheric relief valve is inserted between the non-return valve and the heater connection on the turbine to prevent an unduly high pressure being produced in the high-pressure end of the turbine casing in the event of the by-pass valve sticking when the stop valve is closed. When no heating-steam is required the whole of the steam entering the machine passes through all the stages into the exhaust, and under these conditions the turbine operates as a straight high-pressure set.

The economies which can be realised by the use of a reducing turbine depend in a large measure on the steam conditions with which it is to operate. In general it is safe to say that the initial pressure should be as high as commercial considerations will allow, and that 150 deg. to 200 deg. F. of superheat is desirable. Every endeavour should be made to keep the pressure at the heating-steam outlet on the turbine as little as possible above that required at the heating plant, for which reason all the valves in the heating system—of which there are usually a large number—should be of high-class design, suitable for high temperatures and able to pass the full steam quantity with as small a drop in pressure as is practicable. This drop in pressure should be guaranteed by the valve maker—a practice which, if followed in ordering valves for all purposes, would have considerable effect in improving their design. In many cases manufacturers are asked to supply sets designed for heating-steam pressures of from 40 to 60 lb. per sq. in. in cases where 10 lb. per sq. in., or even lower pressures, would be quite suitable. The higher pressure is often given because steam has always been supplied at that pressure, and any change is opposed from a fear that heating will not be so efficient, and may even be impossible if the pressure is lowered.

In the vast majority of cases the heating-steam can be supplied at, or a little over, atmospheric pressure, and under this head fall nearly all those cases in which steam is required to heat or boil liquids in open vats or maintain temperatures below 220 deg. F.

The enormous increase in the work capacity of heating-steam which accompanies a decrease in back pressure is shown graphically in fig. 7.

It will be seen that with steam at an initial pressure of 180 lb. per sq. in. and a superheat of 150 deg. F., the work which can be obtained is doubled by reducing the heating-steam pressure from 60 lb./sq. in. g. to 10 lb./sq. in. g., so that if 20,000 lb. of heating-steam is required for 3,000 hours per annum, an additional 654,000 KW.-hours can be obtained with the reduction in heating steam pressure stated, representing an annual saving of over £1,350 if electricity is valued at ¼d. per unit.

One of the great advantages of a reducing turbine, as compared with a reducing engine, arises from the fact that the mechanical losses are only from 1 to 2 per cent. of the output, and that the radiation losses are usually only about 0.5 per cent. of the heat supplied to it, so that all the losses except 1.5 to 2.5 per cent. appear as useful heat in the heater

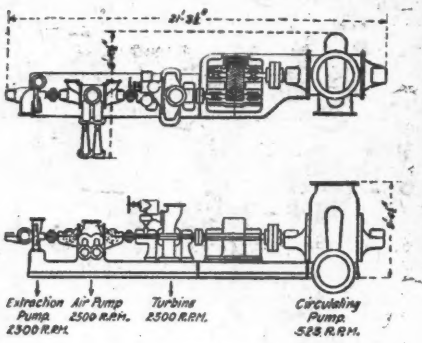

FIG. 6.—DIMENSIONS OF PUMPING SET.

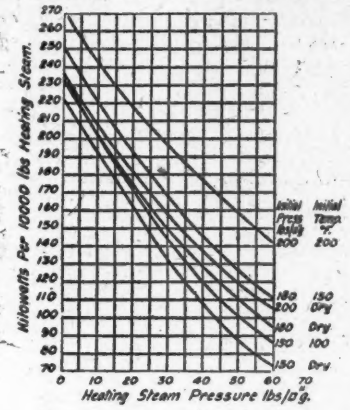

FIG. 7.—POWER OBTAINED FROM HEATING-STEAM.

mains. The mechanical losses of back-pressure engines can be anything greater than 6 per cent., particularly if the back-pressure is substantially greater than atmospheric, when the dimensions become very large relatively to the capacity of the set. The increased heat radiated from the engine cylinders can be appreciated from the fact that, while in a reducing turbine the heating-steam performs the whole of its work in less than 1/600 of a second, it would remain in an engine cylinder for about three-quarters of a second.

There are many processes requiring heating-steam, in which the steam is passed directly into the liquid to be heated; in such cases it is imperative that the steam shall contain no trace of oil. As the steam from the reducing turbine is entirely free from oil, it is in many cases the only type of prime mover which can be employed.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

[*Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest to our readers.*—EDS. ELEC. REV.]

Cantie Patent Fuse Gear.

WE have received from the CANTIE SWITCH CO., LTD., of 67, Mount Street, Nottingham, a specimen of their new patent fuses, the constructional features of which are shown in fig. 1, while a complete fuse board with the cover removed is shown in fig. 2.

Both the fuse base and holder are substantial pieces of china; the contacts, sockets, &c., are of heavy copper and brass; the live base terminals are sunk, and safe from accidental contact, while the bridge has a wide flange which effectually shields the fuse terminals.

Both base and bridge are designed so that there is no direct line metal to metal, thus making it difficult for an arc to form. The makers advocate copper fuse wire, and this is attached to the bridge terminals by milled clamping nuts, and bent so as to lie in a central asbestos-lined channel; a special feature is the short fuse length—only 2 in. in the 50-ampere size—which leads to a marked reduction in energy loss on full load and substantial monetary savings. The bridge handle is well ventilated and cool in use. The fuse bases are carried on bars in a substantial iron distribution box, and any base can be removed singly in two minutes, or all the bases with the bus-bars behind can be taken out together.

No fillets are required in the box, owing to the substantial china walls of the bases. The cable sockets fit in split holes tightened by a screw from the front.

The boards are supplied in 1 to 12 ways, for double and triple-pole circuits of 10 to 50 amps. per way; the design is a pleasing one, and, we should judge, is sound both mechanically and electrically.

We understand that very satisfactory tests in practical use have been carried out with considerable currents, the fuse clearing itself without damage to contacts or china.

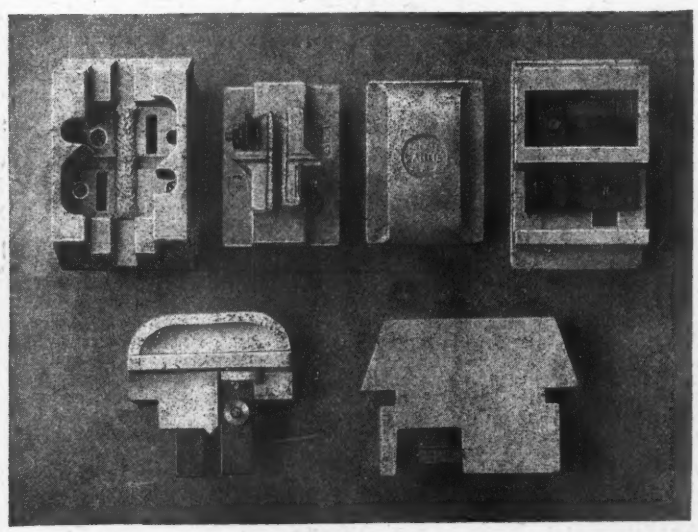

FIG. 1.—CANTIE PATENT FUSE: VIEWS SHOWING TOP OF BASE, UNDERSIDE AND TOP OF BRIDGE, UNDERSIDE OF BASE, AND ELEVATIONS OF BRIDGE AND BASE.

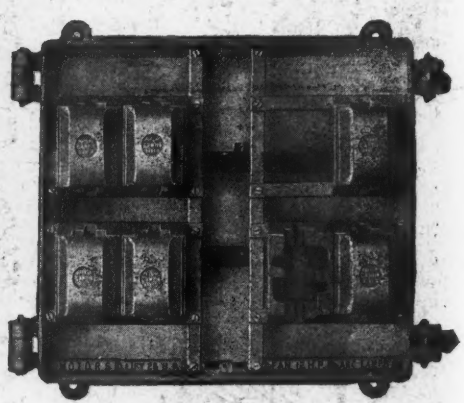

FIG. 2.—CANTIE DISTRIBUTION BOX.

New Electric Steel Furnace.

A NEW type of electric steel furnace, known as the Greaves-Etchells furnace, is being built by Messrs. T. H. WATSON AND CO., of Sheffield. It is suitable for making all grades of alloy steels and high-speed tool steels in small ingots. The furnace is a three-phase furnace in which two of the carbons are introduced at the top, and the whole of the hearth is connected to the third phase, acting as the third electrode. With a small furnace designed to melt 6 cwt. in three hours, it has been found possible to obtain five heats of 18 per cent. high-speed steel in 10 hours. The longest time occupied from charging to finished ingots was 1 hr. 40 min., and the shortest time 1 hr. 15 min. This small furnace has already made over 560 consecutive heats of high-speed steel, and the lining has once been renewed. The standard size in which this type of furnace is being built is for a capacity of 10 to 12½ cwt., but some furnaces are also being built for larger sizes, up to six tons.—*Metallurgical and Chemical Engineering.*

Chemically Pure Battery Plates.

A TYPE of plate known as the "chemically pure" which has recently been placed on the market by the Gould Storage Battery Co., New York City, has been designed with a view to greatly increasing the life of the positive plate and making it more nearly approximate that of the negative plate. The process of formation of the plate is entirely different from the electrochemical processes hitherto employed in the manufacture of Gould Plantè plates. The chemically pure active material of the new plate, with a higher capacity per sq. in. surface than the old plate, now makes it possible to obtain normal battery capacity with a smaller plate surface than formerly. This permits the use of heavier ribs and wider acid space between the ribs. There is a somewhat heavier

section of reserve lead in the ribs of the plate for future conversion into peroxide, and the active material being formed in a thin but very dense skin over the surface of the ribs, the grooves between the ribs are left open clear to the bottom, permitting free circulation of electrolyte. The battery gives a somewhat higher voltage on discharge, and reaches a full state of charge at a slightly lower voltage than is experienced with the older type of plate.—*Electrical World.*

LEGAL.

Meirowsky Insulating Tubes.

A problem of the English manufacture of insulating tubes occupied the Patents Court on Wednesday, when Mr. H. Clarke, of Messrs. H. Clarke & Co., the Atlas Works, Hullard Street, Old Trafford, Manchester, applied for a licence to use Patent No. 26,941, of 1906, covering an improved method and apparatus for forming insulating tubes. The Controller, Mr. Temple Franks, and Sir Cornelius Dalton heard the application.

The patent is in the name of Max Meirowsky, and claims a method of forming insulating tubes by means of a mandrel, around which the material to be wound is passed perpendicularly to the axis of the mandrel, as distinguished from spirally. The fibrous material, which may be wound together with insulating material, and is of breadth equal to the length of the tube to be formed, is powerfully stretched before being wound on the mandrel, so that the fibrous material, during the winding operation itself, forms the outer pressure mould, or former, and the materials are wound with perfectly uniform tightness, while dispensing with a stationary pressure support or roller.

In another claim the stretched fibrous material, before being wound, is led between two heated rollers, and the freely movable independent mandrel is, during the winding operation, pressed uniformly against the surface of the hot rollers, so that the layers of material to be wound are, before being joined to those already wound, and the latter are, before receiving new layers of material, strongly heated from the exterior.

Mr. Worsnup, Manchester, appeared for the applicant, and Mr. Rudolf Moritz was counsel on behalf of respondents.

Mr. Worsnup stated that the applicant was originally in the employ of Meirowsky & Co., the patentees, who had branch works in Manchester. At the outbreak of the war they were represented here by a Mr. Schultz. Mr. Clarke, in October, 1915, commenced business on his own account, and, later, Mr. Schultz visited him, at his invitation, to look at a machine which he had built, and threatened proceedings for infringement. When asked what was their authority, Mr. Schultz's firm replied that they had control of the patent by permission of the Public Trustee. The applicant inquired whether this was so, and was told by the Public Trustee that he had given no authority whatever. Mr. Clarke was advised by his patent agent that he was not infringing. He, however, thought it was the proper course to come to the Court and ask for a licence.

Mr. H. Clarke, answering the Controller, said it was possible to make tubes of this character without using any specific machine. They were being made on several machines at the present moment.

Mr. Moritz, intervening, observed that the patent now being applied for was both a process and an apparatus patent. There was a particular method of winding in relation to the mandrel—perpendicularly to the axis, as distinguished from spirally.

Mr. Clarke added that he had been deterred from developing his connection to some exent by this threat of infringement.

Mr. Moritz explained that Mr. Geo. Schultz had changed his name to Scott, and was now Captain Scott, of His Majesty's Forces. Captain Scott had conducted the English business of Meirowsky, and with the outbreak of the war the English liability of carrying on fell on Captain Scott. It was a partnership between Captain Scott and Meirowsky. When Captain Scott joined the Forces, he invited Messrs. Schultz & Co., the well-known electrical engineers, whose managing director was his father, to go to Manchester, take up the English business of Meirowsky & Co., and manufacture. Captain Scott was an English-born son of Mr. Schultz, who himself was born in the free city of Hamburg as it then was, and naturalised in this country in the early sixties.

Cross-examined by Mr. Moritz, Mr. Clarke said the experience he gained in his employment guided him in building a machine, and it wound perpendicularly upon the mandrel, and employed heavy pressure and hot rollers. He should say that in broad principles the machines were not the same. He did not wind the tubes under heat and "great pressure"; there was a certain amount of pressure but not pressure caused by stretching the fibrous material. His machine had not a brake, like the patented machine, and it contained a roller for winding crafts paper. In all the time that he was with Meirowsky & Co. he did not know that theirs was a patented machine. There was no mark upon it. It was by pure inadvertence that when he began he placed on his note heading "late G. Schultz & Co., Ltd." It should have been "late of," and when his attention was called to the mistake (which, he admitted, was careless) he at once remedied it. He recalled no statement by young Mr. Scott, when that firm was building a larger machine, to the effect that the machine was patented. Meirowsky & Co.'s works were now closed.

Mr. Moritz contended that Messrs. Schultz & Co. under the new arrangement could supply all public requirements, and having regard to all the circumstances, this was not a case where the Court should interfere, and so encourage an English employé of a German firm to start independently and build a plant, and then come to the Court for a licence.

The Controller: Supposing the German business had been closed at the outbreak of war. We have had many cases in which a manager has come at once for a licence to manufacture. Mr. Clarke may be in a not entirely dissimilar position.

Mr. Moritz: At the time of the war Capt. Scott was an English subject, and has always been one. He called on his father, managing director of Schultz & Co., to go to Manchester and seize the business and carry on. There was a power of attorney. Messrs. Schultz proposed to shift the necessary plant to their London works, where they would carry on, and then, he supposed, the Board of Trade would wind up the business of Meirowsky & Co. If they did, Messrs. Schultz & Co. would apply for the patent, and acquire it. They had done trade with the Admiralty of £3,000 or £4,000 a year in these tubes. Capt. Scott was the person entitled to manufacture in this country under his agreement, and the arrangement could be called either an exclusive licence or a partnership. It dated from September, 1912, and was to terminate in December, 1917. (Mr. Moritz then produced the agreement, in German.) The patentees, he said, gave the agency for carrying on the manufacture in England. There was a clause to the effect that if Capt. Scott's father died, or left his business, the son was to be relieved of his partnership, in order to go and take up Schultz & Co. The business transactions were to be carried out in the name of Meirowsky & Co., and Capt. Scott was to have the full use of the English patents—an exclusive licence. Of course, as to whether Capt. Scott's power of authority to his father to take the business at once was a strictly legal transaction, counsel did not know.

The Controller: It is quite conceivable that that agreement was suspended by the war. The Courts have held that an agreement of that kind was put an end to. Captain Scott's agreement was with a purely German firm. People left in that position with an agreement have come here to ask for a licence, and have produced their agreement, and said, "We want to carry on;" and we have given them a licence in dozens of cases. We have said, "We cannot give you an exclusive licence, but if you are fulfilling the needs of the country, you have a right to come here and say so." It would have been very much better if Captain Scott had come here for a licence in the first instance, because the whole affair, as it seems to me, is a hopeless one at the present time.

Mr. Moritz: They have laid it before the Board of Trade, and the Board of Trade have said, "Go on."

The Controller: The Board of Trade should not have done so. We shall have to consider this case.

Mr. Moritz: In the meantime, the Board of Trade intend to wind up Meirowsky & Co. Messrs. Schultz, intending to manufacture in London, have sold some of the machines.

The Controller observed that he would look into the terms of the agreement. The Court would no doubt have given Captain Scott a licence if he had applied, though an exclusive licence was a different question. The applicant's method might be called sharp practice, but it was constantly done; he might have felt that the company which had employed him was destined to be wound up.

Mr. Geo. Schultz said he was managing director of Schultz and Co., whose subscribed capital was all English. Both his sons had assumed the name of Scott. When he himself went to Manchester and took charge of this business, he informed the Board of Trade, and they approved. He had that day received a notice that the Board of Trade were going to look into the affairs of Meirowsky & Co. It was in the autumn of last year that he found the Manchester works very inconvenient. They then had ample stocks in hand for meeting all demands, and were bringing a machine to London for the purpose of carrying out Government work. They had calls from the Admiralty, and had recently brought to the notice of the Admiralty a speciality in connection with mica tubes, which overcame one of the difficulties in connection with micanite tubes. It had been arranged that the one firm should manufacture for the other, and they were in a position to meet all possible demands. Meirowsky & Co. at one time ran five machines.

Mr. Arthur Wm. Scott, son of the last witness and brother of Captain Scott, said the firm of Meirowsky & Co. had a contract with the Admiralty to supply them with so many tubes for three years. When the Admiralty wanted tubes of 18 in. diameter inside and 20 in. outside he proceeded to devise a special machine, for which Geo. Schultz & Co. now held the patent. Arrangements had been made for meeting all the orders entrusted to them upon the patented machine.

The Controller: It seems to me that if you have been carrying on the business of Meirowsky & Co. you ought to have been paying over your profits to the Public Trustee as custodian.

Mr. Moritz: The business has been carried on at a loss since the outbreak of the war.

Sir Cornelius Dalton: How would you be injured if a licence were granted to Mr. Clarke?

Mr. Scott: He is our competitor in the Manchester district, where we are established. We are also expecting an infringement in another quarter.

Replying to the Controller, Mr. Moritz said these tubes were largely used for wireless apparatus. He suggested that if the Board granted a licence to the applicant in the present case, they would have gone further than they had ever gone before. Having built a machine, he came and asked the Court to protect him against the consequences.

The Controller: You may call it sharp practice, but you have to remember what the company was. Meirowsky & Co. was an alien enemy business, and the question is whether we should over

look such sharp practice for the purpose of facilitating the trade of the country.

Mr. Moritz: When Capt. Scott comes back he will legitimately expect to have anything that is going in the way of Meirowsky's business.

The Controller: It may appear that Capt. Scott is the agent of Meirowsky.

Mr. Clarke offered 5 per cent. royalty on the selling price, and Mr. Moritz announced that the opponents would apply for a licence and offer the same percentage.

The Controller: We shall have to consider the case of Meirowsky, and look into the details. The licence of Meirowsky does not convey an interest in the patent. I will report to the Board of Trade, in due course, on the evidence presented at the hearing of this application.

Vaughan & Co. *v.* Golder's Green Amusement and Development Co.

After a long interval of adjournment, occasioned partly by the illness of a witness and partly by the necessity to make way for other cases, the action being heard by Mr. Pollock, one of the High Court Official Referees, again stood adjourned indefinitely on February 8th, owing to other actions being interposed.

W. Vaughan & Co., Ltd., electrical engineers, of Cross Street, Islington, sought to recover from the Golder's Green Amusement and Development Co., Ltd., of Duke Street, St. James', the balance of charges for fitting up electrical installations at the defendants' new theatre of varieties at Golder's Green. Damages were also claimed for breach of contract both by plaintiffs and defendants. The case involved two novel questions of law, one being as to whether, notice of the assignment of the debt not having been served upon the defendants, the plaintiffs were entitled to sue, and the other whether damages could be claimed against the plaintiffs, they not being the contractors who had carried out the work, but a company to whom the business of the contracting firm had passed.

Mr. Copping, holding a brief for Mr. C. A. Bennett, appeared for the plaintiff, and Mr. Ernest Pollock, K.C., for the defendants.

According to Mr. Copping's opening for the plaintiffs, the contract was to put in the electric installation for £1,700, the work to be completed to the satisfaction of the consulting engineer, Mr. A. E. Mitchell, and payments were to be made upon the certificate of the architect, Mr. B. Crewe, at the rate of 75 per cent. of the value of the work executed; half the balance was to be paid on completion, and the remainder in six months after the date of the consulting engineer's certificate of completion. The plaintiffs duly erected and equipped the installation in accordance with the contract, in addition to which they executed certain extra work, for which they claimed £500 odd. The whole of the work was completed in March, 1914. Since completion of the work, the company which carried it out had been reconstructed, and the present plaintiffs were the assignees of its assets and its debts. A great deal of difficulty had arisen from the supply pressure provided by the Hendon Electric Supply Co. being 3,000 instead of 200 volts, which necessitated a large portion of the plant being scrapped. According to the contract the work was to be completed by March, 1914, but it was, in fact, sufficiently completed to allow the theatre to be opened on Boxing Day, 1913. The defendants admitted the contract, but did not admit that T. W. Vaughan and Co., Ltd., did the work, and they said that the work was incomplete and defective and not in accordance with the contract, and they denied liability to pay for any extra work beyond that provided for by the contract. It was provided in the specification that all main and sub-circuit cables, leads, &c., should be designed to have a current density not exceeding 750 amperes per sq. in., for which purpose the incandescent lamps were to be taken at certain amperages mentioned. This provision, they said, had been disregarded throughout, and cables and leads of smaller sizes than those provided for had been substituted. Moreover, the conduits throughout were too small, and could not carry cables and leads of the size specified. By reason of this, it was alleged, it would be necessary to re-wire throughout. The specification provided that the bases of all boards should be of polished slate or marble of, in the large sizes, at least 1¾ in. in thickness, but the large boards or bases were not of that thickness. There were a number of other details which were said not to be in accordance with the contract. The defendants did not admit that the payments they had made had been on account of the claim of £1,700, the contract price, and the clause of £559 for extras, but said that they had been made on the architect's certificates for work done, and they counterclaimed £1,000 for breach of contract. The plaintiffs denied the defendants' allegations.

Mr. Ernest Pollock, K.C., said it would have to be proved that there was an assignment of the debts from the one company to the other. No notice of the assignment had been served upon the defendants, and the plaintiffs had no right to sue.

Mr. Copping said that the correspondence would afford ample evidence that the defendants had notice.

The Official Referee thought that the point as to whether the plaintiffs were entitled to sue should be dealt with first. Unless that point were established, the plaintiffs would have no case, and it would be waste of time to go into the other matters until plaintiffs' position had been established.

Mr. Copping argued that it would be convenient to have the amounts settled before the point of law was decided, as, in the event of a decision being given in his favour by another Court, the whole thing would have to be gone over *de novo*.

Counsel for the defendants raised the point that the plaintiffs, not being the parties with whom the contract was made, were not in a position to claim against them for breach of contract.

Mr. Copping said that in that case the plaintiffs would put themselves in exactly the same position as if they were the contracting company, taking all the liabilities as well as the assets. He offered to put them in the same position as that in which they would have stood had they been actually parties to the contract.

Mr. Ernest Pollock, K.C., said that he must decline to accept the offer.

The case was adjourned, and, upon the hearing being resumed after an interval of three weeks, Mr. Copping said that before proceeding with the evidence he desired to apply to join the old company as plaintiffs, as he had got from Mr. Justice Astbury, who was the Companies Judge for the current term, an extending order for the winding-up of the old company until August next.

Mr. Pollock, on behalf of the defendants, resisted the application, pointing out that after correspondence between the parties on the subject, the writ was issued by J. W. Vaughan & Co. (1914), Ltd. He cited authorities, upon which he contended that the notice of assignment was bad as not being in accordance with the Judicature Act. He said that in the middle of the case, after the adjournment and after they had all come to fight on the basis of the point raised in the pleadings, and after the delivery of the defence, it was now concluded that the old company could be joined. That, he said, was not right.

The Referee: Supposing they paid the whole of the costs up to the present time?

Mr. Pollock: Yes; if we are put in a position to enforce our full counterclaim. If they paid the whole of the costs up to date, the whole company might be joined. In any case, it would be a misfortune if they were not to go through with the case on the question of figures.

Mr. Copping said that he had already offered to place the new company upon the same footing as the old, and accept all liabilities as well as assets.

The Referee said that there had been no equitable assignment because no notice had been given of those to whom the debt had been assigned, and the plaintiffs had all along assumed that they were entitled to sue in their own right as if they were the contractors.

Mr. Copping said that it was only a question of notice, and they had a perfectly good assignment both in law and in equity.

The Referee said that the amendment could be made at any time, and the only question was upon what terms.

Mr. Pollock said it appeared there was a confession on the part of the plaintiffs that if the case went on as at present stated they would fail, and therefore they were desirous of fighting the claim on some other ground.

The Referee said it was a singular position of things. There was a company which had entered into a contract to do certain work, which, the defendants said, had not been done properly. The company which did the work went into liquidation, and started again as J. W. Vaughan & Co., Ltd. (1914), and they dealt with the matter throughout as if they were in precisely the same position after the assignment as the original company. They never gave any notice or intimation before the action that they were the persons who were entitled to recover in respect of the debts of Vaughan & Co., and they showed distinctly that they were claiming as if they were the original contractors. Having brought their action, a defence was set up, and they were asked to state when the assignment took place. That was the position of things when the case came to trial. There had been no equitable assignment, because it was never intimated to the defendants that the debt had been assigned. On the contrary, the plaintiffs had allowed the defendants to believe that they were suing as the original contractors. It was quite clear also that there was no legal assignment. If an amendment of the pleadings was now to be made, it resolved itself into a question of terms. It seemed to him that the order for amendment ought to be made on the terms that the plaintiffs paid the costs up to the present time.

Mr. Copping asked that the order should be made in a form which would enable him to appeal.

The Referee: I decline to allow the amendment unless the plaintiffs pay the costs up to the present time.

After some discussion, it was decided to go on with the hearing, and witnesses were called in support of the plaintiffs' case,

Mr. Edward Mitchell, consulting engineer, of 110, Cannon Street, E.C., giving evidence upon the details of the specifications under which the work was carried out.

The hearing was adjourned.

Telephones and War Surcharges.

The Postmaster-General sued Messrs. Harry South & Lambe, trading as the Stanneries Metal Works, 48-50, Waterloo Street, for £3, in the City of London Court, on February 8th, before Sir John Paget, Bart., K.C., Deputy Judge, for the balance of telephone charges.

Mr. Ward, defendants' solicitor, said he had raised a counterclaim for loss suffered by the defendants through having the telephone cut off, but objection had been raised by the Postmaster-General, who said no one had any right to claim damages against the Crown, except through the old form of a petition of right. Seeing that the telephone service was a commercial business, the British public ought to be able to deal with it as if it were an ordinary trading community. It was very unfair that a claim for damages could not be raised against the Postmaster-General.

Mr. Alsop, solicitor for the Postmaster-General, said, as regarded the telephone service being a commercial undertaking, it was an undertaking for the benefit of the State and all the inhabitants.

The Deputy Judge said he could not entertain the counter-claim.

Mr. Alsop explained that the defendants entered into an agreement for a year with the usual annual subscription of £5 and £1 10s. for minimum message fees. The £3 10s. had been paid, and £3 was now due. At the top of the contract it said "War Surcharge, £4." Defendants paid the £4 when they sent the application form. The extra £4 had to be charged by the Postmaster-General because he was unable to get any money from the Treasury with which to construct new telephone lines.

Mr. Hall, in the contract office of the telephone service, proved making the agreement with the defendants, and said he explained the war surcharge at the time. The £4 was added in September, 1915.

One of the defendants, Mr. South, declared that he was not told anything about having to pay an additional £4 when he entered into the contract. He was quite sure nothing was said about it, and if he had known that the Postmaster-General wanted £11 10s. for a year's telephone service, he would have done without it. The Postmaster had cut off the telephone after a very short time, and what it amounted to was that the Postmaster-General had got the money and the goods.

Mr. Alsop added that the £4 was only charged when the subscriber needed the telephone put on in a hurry.

Mr. Ward, defendants' solicitor, suggested that his clients had been hardly treated by the Post Office.

The Deputy Judge said that was so, unless they had been pretty obstinate. He could not hold that the Postmaster-General's staff had said nothing to the defendants about the £4 surcharge. A Government department did not do that sort of thing. Judgment for the plaintiffs, with costs.

Electrically-Welded Flexible Tubing.

Mr. Temple Franks and Sir Cornelius Dalton, in the Patents Court, heard an application by the United Flexible Metallic Tubing Co., Ltd., of 112, Queen Victoria Street, E.C., for a licence to use the German patent No. 3,822, of 1909, for a form of metal tubing which can be used for covering electric cables, the characteristic of which is that a metal band is wound in the form of a screw-thread, and has its edges welded, the joints being welded together by autogenous or electric welding. For the production of tubes of this kind, the specification states, electric resistance welding, as well as autogenous welding (acetylene welding), may be employed. In that case, the welding of the joints of the tube could be done through the winding of the tube on the ordinary tube-winding machine, in which case the winding spindle would form one electrode and one of the winding rollers of the winding head the other electrode. The longitudinal section of the wall of the tube, when constructed, has the configuration of a waved line, and the tube readily bends by reason of the corrugation.

Mr. Wm. Berryman, applicants' works manager, said the applicant firm already made a flexible tube which was used for cables, of an entirely different construction. That was in the form of rings or, in section, interlocking strips, each coiled upon itself, and so permitting play backwards and forwards. Where there was much vibration, there was a disadvantage in continuous sliding of these parts and the wear and tear involved. This was avoided in the patent tube, which, however, was less flexible than their own. For particular uses, the corrugation took different designs in section. The system of jointing was peculiar. The form of tubing covered by the German patent was not being manufactured in this country at the present moment. The applicant firm was entirely British, with no alien enemy shareholders, and employed about 300 hands. They made four million feet of tubing last year, or 760 miles, in sizes ranging from ¼ in. diameter to 15 in. The patented tubing was suitable for heating and cooling, and avoided the disadvantage more of the applicants' asbestos packing, where there was wet steam or vibration. The flexibility of the tube was obtained from the spring of the metal. The applicants offered a royalty of 5 per cent. on the selling price of the tubing, and the Controller announced that he would advise the Board of Trade to issue the licence.

Actions against Carlisle Electric Tramways Co.

At Carlisle County Court, on 6th inst., before Judge Taylor, J. Cassidy, cattle dealer, sued the above company for damages for injuries caused to a number of cattle.

For the plaintiff, it was explained that on September 22nd, when it was very dark, a number of cattle belonging to the plaintiff were being driven along Port Road, when a tramcar approached, and, despite the shouting of the drover, ran into the cattle, damaging several. It was contended that the car was driven at an unreasonable speed by a boy, and was inadequately lighted.

Damage was admitted, but on behalf of the defendants, it was submitted there was no proof of negligence, and it was contended that to drive cattle through dark streets under present conditions amounted to contributory negligence. It was stated that the car driver was 17 years of age, and it was admitted that he had had a week's training.

His Honour, in giving judgment for the plaintiff for £23, the sum claimed, said it seemed remarkable to him that in a city the size of Carlisle it should be possible to run tramcars up to a speed of 12 miles an hour, in charge of young men of 16 or 17 years of age, with the streets in their present condition. The authorities should see that this condition of things did not exist any longer

A second case was down for hearing, in which T. Clarke, farmer, sought to recover £95 for damage to cattle, but, in view of the previous decision, judgment was entered for the plaintiff by consent for £70, and costs.

Alperton Rubber Co. *v.* Manning and Others.

In this action, which was brought to restrain a disclosure and use of the plaintiff company's secret formulæ for the manufacture of hard rubber for insulating processes and the like, Mr. Justice Peterson, in the Chancery Division, delivered his reserved judgment on Tuesday, February 13th.

The plaintiffs alleged that Manning, on leaving their employ, took with him a book containing certain formulæ. He had since entered the employ of the second defendants, the Belgium Tire Co., Ltd., and disclosed the formulæ to them; and the company had used such formulæ in executing orders for their customers. Manning claimed the right to use the formulæ as part of his business experience and equipment, and the defendant company denied that any orders executed by them were executed in accordance with any formulæ obtained from the plaintiffs.

His Lordship held that for Manning to disclose secret formulæ obtained by him while in the plaintiffs' employ was a breach of contract either express or implied. He found as a fact, that certain formulæ had been disclosed and used by the Belgian company, but others had not. He accordingly directed that the book which was in Court should be delivered up to the plaintiffs, and granted an injunction, with costs, except so far as they had been increased by the issues on which the plaintiffs had failed.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

British v. German Manufactures.

I esteem it a compliment that you should have found the time and inclination to comment upon my letter of the 22nd ultimo.

It is a little unfortunate that you should have been somewhat vague in the application of the motto which you so kindly present to me, for the subsequent context leaves one a little in doubt whether it is the gentle Hun or myself that you are pleased to designate as the "Devil" when you construe it by such a "homely expression," but which I shou'd prefer to call a loose expression, for I am sure that if in our college days either of us had so construed it we should have incurred the righteous indignation of our respective tutors.

I have to compliment you on the manner in which you have skated over what one may call your *faux pas* in not having taken the precaution to be sure of your facts before giving publicity to an alleged breakdown to the Newport plant. In fact, a perusal of your reply leaves the impression that you dealt with my letter somewhat hurriedly. Anyone reading my communication with ordinary intelligent carefulness could be under no misapprehension as to my view of what should be the future policy of this country towards German manufactures after the war. There are numerous occasions in the course of my communication where this is made quite evident, but to none of which you refer. Incidentally, there is a printer's error which, unfortunately, rather destroys the sense of the tenth paragraph in my letter. The sentence, "Certainly, I could not imagine any giving the Germany market an opportunity to tender," should obviously have read, "Certainly, I could not imagine any *municipal authority*, &c." The omitted words appeared in my original.

As a matter of fact, I was almost afraid that my views on this point would be regarded as rather Utopian, and therefore when, in my concluding paragraph, I referred to the necessity for a "broad-minded industrial international policy," I hoped that the preceding substance of my communication would have left no possibility of a misunderstanding in regard to the use of that expression, since the total exclusion of the Austro-German market was evidently regarded by me as an essential basis upon which to build such policy, and that obviously by their total exclusion in such matters they would *ipso jure* be placed outside the scope of any such arrangement. Therefore, it could not have been in my mind to have included them in any such foreshadowed policy. It is some little satisfaction to me to have read during the week-end the views of others all tending in the same direction, perhaps most forcibly expressed in the *Observer*.

I must further congratulate you on so carefully omitting all reference to what I take the liberty to consider the most important paragraph in my communication, if any part whatever could be so dignified, namely, my reference to your own admission as to what was the one great danger to be guarded against. It is only natural, I suppose, that you should have omitted

it, as no keen debater or critic will go out of his way to draw attention to an evident weakness in his own case. Generally speaking, I submit it was perfectly clear that I was not attacking your leader from any desire to defend, even in what you do me the honour to admit was a judicial and impartial manner, the position of German manufactures, but solely because I considered it was your evident intention to make the whole question a "stalking horse" for the furtherance of a certain political propaganda.

Regarding my alleged detachment from mundane affairs, what precise connection there is between detachment from mundane affairs and the holding of a judicial and impartial opinion on the relative merits of British and German manufactures I am at a little loss to understand. Here, again, I am afraid your phraseology is a little unhappy. Anyone who knows me, or has had the opportunity of personal contact with me during the past two years, will know how utterly unjustified such an allegation is, and I am afraid that in attempting in a veiled manner to cast some suspicion upon my patriotism by an *argumentum ad populum* you have not done yourself justice. It has been my good fortune to have had considerable opportunities of assisting in the great cause quite outside the heavy work of my department.

In conclusion, my sole object in writing, and I think I have made it abundantly clear, was to controvert what I considered to be arguments extremely illogical, and without due regard to the *status quo ante bellum*. I am afraid there is a great deal yet to be done in the way of removing some of our unfortunate insular prejudices, and, perhaps, too exalted opinion of our national superiority. It is, I submit, an undeniable fact that many of the disappointments and disillusions of the past two years have found their genesis in these characteristics, and since you appear to have an inclination for presenting mottoes to the undeserving, I suggest there is one which we all might with advantage adopt, namely, "*Fas est et ab hoste doceri.*"

Whilst I am aware that I have perhaps occupied already too much of your valuable space, I will thank you to do me the favour of publishing this reply.

A. Nichols Moore, *Borough Electrical Engineer.*

Newport, Mon., *February 5th*, 1917.

[We regret the unfortunate printer's error, due to a line of type being misplaced.—EDS. ELEC. REV.]

It is indeed refreshing in these momentous times to read such a letter as has emanated from Mr. A. Nichols Moore, borough electrical engineer of Newport, and which appeared in your issue of February 2nd. Here is no weak-kneed free trader renouncing his principles because of the war, no politician trimming his sails to catch the popular breeze. No, we have here a gentleman in an important and responsible position, a borough electrical engineer, monarch of all he surveys (except his committee, perhaps), before whom the unfortunate British manufacturer cringes and trembles, who, when he has not been busy buying German machinery, has evidently been pondering on the incapacity of the home manufacturers.

With his remarks on the actual virtues of the British and German machinery we are not concerned; in fact we are willing to assume that the latter is the better, but let us go deeper than Mr. Nichols Moore has groped. How did the Germans get their experience? Did the German municipalities or supply companies put up their own manufacturers (favoured as they were by a considerable tariff) against foreign makers? We trow not. No, the German manufacturer obtained his experience because he was given his opportunity, and was helped by his Government to make a profit to pay for his experience. This borough electrical engineer (we must be thankful that there are many exceptions) grudges the British manufacturer any profit, makes him pay higher wages, and, would you believe it, actually takes his money (i.e., his contributions for electrical energy, rates, etc.) to pay his German competitor.

This is an example of the beautiful principles of Free Trade; are we to return to that glorious state after the war, and are our men fighting and dying in thousands for this? Well, it is better to realise what we have in our midst than to imagine we have learned anything since August 4th, 1914. And the same authority cries, "Who in the early summer of 1914 would have questioned the propriety of giving the German market an opportunity to tender?" Aye, who indeed? We are now told to manufacture all we can, to grow all we can, and because, forsooth, this authority foresaw nothing he thinks no one else did. For sheer self-delusion and conceit the Free Trader is only excelled by the Hun. He advocates higher technical education, but no amount of education can overcome unfair competition, and it is evidently our lack of real education that permits us, alone of all the world, to tolerate the promulgation of such fallacies. That education is not the true cause is proved by the progress of the chemical industry alone during the present period of protection.

We are astonished, Mr. Editor, that Mr. Nichols Moore should attack your political tendencies, and lest he should think that we are disappointed tenderers, we may say that although we have had many years' experience of unscrupulous German competition, aided by similar buyers, we are not makers of heavy electrical machinery.

Electrical Manufacturer.

City and Guilds Examinations.

In the fourth paragraph of his letter in your issue of 2nd instant, "No Energy" suggests that the average teacher of electrical-installation work would be unable to express an opinion as to whether the subject was grossly neglected or not. We must decline to believe this, and prefer to give the average teacher credit for understanding the scope of his subject and the way it should be treated.

The average teacher presumably consults the official syllabus, and various requirements in the way of apparatus and material for dealing with the subject both in the workshop and at his lectures, must automatically suggest themselves to him.

What we should like to hear about are:—(*a*) cases where the teacher's efforts are utterly cramped for workshop facilities, and (or) for supplies of apparatus, &c.; and (*b*) cases where the story is quite the reverse.

We think we know enough about the general situation to foretell that the (*a*) cases would form an overwhelming majority.

The pen name adopted by your correspondent seems to indicate that he is not a progressive. As there is nothing in his letter that would offend the most backward head or principal who made a practice of ignoring the subject, he might have revealed his identity. Failing that, his remarks lack weight, and we think we may ignore his numbered items, most of which are more or less beside our point.

The trend of "No Energy's" letter is to the effect that the classes are O.K. but lack support. Our argument is that the poor support is due to gross neglect of the class equipment and facilities; and we think no broad-minded, independent, and progressive person could fail to arrive at the same conclusion.

Though we are not teachers of electrical-installation work, we are in touch with many who are.

A. P. Lundberg & Sons.

London, N., *February 12th*, 1917.

Fuse Failures.

The electrical trade, who have not previously seen the interesting series of photographs exhibited in your last issue, will certainly feel indebted to Mr. S. W. Baynes for allowing them to be published. The design of fuses, their possibilities, their limitations, under ever varying experimental test, and in practice upon a thousand different circuits, is itself the study of a lifetime, and in fact has been the daily work of comparatively few. I am sure Mr. Baynes will accept from one part of them a few remarks in support of a desire for caution, and at the same time a few friendly criticisms.

Mr. Baynes suggests "that cartridge fuses should be so designed that it is impossible to short-circuit them with ordinary fuse wire." This suggestion, offered obviously in all sincerity, is the one proposition that has ever been in the forefront with every "cartridge-fuse designer" upon both continents. If Mr. Baynes then proceeded to offer to the industry a fool-proof "cartridge fuse," which he had designed, which would answer to his own description, then it would indeed be a welcome invention, and add additional lustre to his reputation. Unfortunately, however, neither Mr. Baynes nor anybody else has yet done so, so it next remains to deal with the facts as they arise. Mr. Baynes then proceeds to describe a cartridge fuse which he uses in his "sealed" fuse boxes of the "Zed" type, and which, unless the impression were corrected, might lead the uninitiated to infer are not open to the same objection. This class of fuse, however, is unfortunately very easily tampered with, and owing to the short length of "air break" under such conditions, is probably the most dangerous of its class in this respect. Upon one occasion, and not many miles from the St. Pancras electric works, a serious fire occurred in consequence, and I still possess a part of what was left of the fuse box, and a cork surrounded with twisted fuse wire used as a temporary substitute for the "Zed" type fuse, and the unwitting cause of the disaster. In Northern America, where similar style porcelain fuses are sometimes used, I have seen hundreds of specimens that have been tampered with. They figure on the walls of the fire offices, and of nearly every central-station mains department, and are held up to the public as a warning. I am, of course, not directing this criticism at the "Zed" fuse itself, as a fuse cartridge. For the comparatively small currents for which it has so far been designed, it is excellent, and so long as Mr. Baynes has a reliable staff, and keeps the unbroken seals upon his fuse boxes, it will behave as well as any other good design of cartridge fuse, but directly it is beyond his limited control, it must continue to fail under "abuse." Obviously, occasions will arise when, for some reason or another, the "spare cartridge" is not available, and a temporary expedient is necessary; the "best" cartridge fuse under such circumstances is one designed so that there are "ample clearances," and fixing connections sufficient reasonably to ensure continuity of supply until the temporary expedient has been replaced.

It was perhaps about 14 or 15 years ago that I brought back from Berlin the "Zed" fuse, which I first introduced to Mr. Baynes at St. Pancras for his patent "emergency" fuse box, and my company have been interested in the supply of the cartridges ever since that date. I am naturally gratified, and perhaps a little flattered, in spite of its unwelcome German

origin, that the "Zed" cartridge fuse has fulfilled its allotted task so well. At the same time, and for the same reason, I shall be admitted free from personal bias, when I desire to pay tribute to a British inventor, Mr. W. M. Mordey, the originator of the sand-packed cartridge fuse in universal use throughout Great Britain, standardised by the British Admiralty, and standardised throughout the great North American continent.

Cartridge fuses embodying the original characteristics of this invention, and carrying various improvements, will not only perform all the functions of the German invention, but can be guaranteed to deal, in silence and safety, with capacities and voltages double and treble, and double again, the size of the maximum Teutonic design yet made. Moreover, they always possess the insuperable advantage that in case of dire emergency (e.g., the absence or breakdown of the spare), that they offer a better temporary expedient. Several years ago I was invited by the Newcastle Electric Supply Co. to make up some heavy fuses, larger than any previously contemplated. These were designed upon the lines of Mr. Mordey's original invention, and with certain improvements, the results were truly extraordinary, and the results "beautiful to witness." Many circuit breakers were subjected to the same tests, but all failed but one, and in the case of "the one," the results were somewhat disastrous. I cannot do better, perhaps, than submit herewith a copy of an unsolicited letter, hitherto unpublished in the Press, which was sent to me, giving the result of these trials.

(*Copy.*)

Messrs. Berry, Skinner & Co.,
78, Upper Thames Street, E.C.

Dear Sirs,—I have pleasure in giving you the following account of the test of the large cartridge fuses you supplied to the Newcastle Electricity Supply Co. The test was carried out at our Pandon Dene sub-station, the 600-volt traction battery being used for the purpose.

The fuses were placed straight across the battery without line resistance, other than the connecting leads, which were of 0.5 sq. in. section approx.; and about 6 ft. of bare copper conductor of smaller section as a safety device. When the circuit was closed, the testing engineer and all present were greatly surprised at the action of the fuse, which blew without any external sign, except a slight hiss.

I witnessed two tests on your fuses with the same result, and a third test on a well-known make of circuit breaker, with magnetic blow-out. The latter had a far more disturbing effect on the battery connections, and did not break the circuits as rapidly as your fuses.

When it was observed that your fuse was designed to carry 2,000 amps. continuously the result was quite wonderful. It was, in fact, the only device tested which could have been satisfactorily erected on a switchboard. All the other apparatus tested arced, and unless specially placed would have been dangerous.

The battery used for the purpose of the test was the largest in the country, and in consequence the test was very much more severe than if the fuses had been shorted across the terminals of a traction generator. I have only once previously seen a similar test, on a smaller battery, and in that case the ordinary forms of circuit-breaker failed conspicuously, due to the contacts welding together.

In my experience, it is much more difficult to break an arc with a 600-volt continuous current than with the same power at a higher voltage.

You are at liberty to make use of this letter should you wish it.—Yours faithfully, C. CAREW GIBSON.

The vast possibilities of the powder-filled cartridge fuse will be interesting reading for many of your readers. It is gratifying to know that we need not go to Germany to find the inventor of the best type of cartridge fuse, and still more reassuring to realise that the National Board of Underwriters of the United States of America have standardised on the invention of a British-born subject.

In conclusion, I desire gratefully to acknowledge the privilege Mr. Baynes gave me several years ago, actually to witness a series of tests upon "rewireable" fuses, and in particular for testing one of my company's standard "Masta" fuse-switch boxes, under identical conditions. The size selected by me for the purpose exceeded by 50 per cent. the largest "Zed" type fuse made. The results, needless to say, were that the circuit was interrupted practically noiselessly, and without arcing, and the cartridge when sawn in half afterwards by Mr. Baynes's assistant, Mr. Walters, was, with the exception of the melted fuse wire, quite intact. Needless to say, Mr. Baynes, with characteristic promptitude, at once gave permission for such apparatus to be used upon the St. Pancras supply, a graceful concession, having regard to the fact that the requisite provision for such apparatus had been overlooked, when the local rules and regulations were re-printed.

Herbert H. Berry.

London, E.C., *February 12th*, 1917.

The Kilowatt Publishing Co., Ltd.

In amplification of the note published in your issue of January 12th, announcing the voluntary liquidation of the Kilowatt Publishing Co., Ltd., I shall be glad if you will allow me to add that the decision of the directors to cease publishing "Electrical Engineering" at the end of last year was arrived at in consequence of the depletion of the staff, and that all creditors of the company have been paid in full.

Although other duties have prevented my taking any active part in the publication of "Electrical Engineering" or the affairs of the Kilowatt Publishing Co. for some considerable time, my name has been so intimately connected with "Electrical Engineering" during the ten years of its publication that I should like the above facts to be made known to your readers, to avoid any wrong interpretation being placed upon the note which you published.

F. Charles Raphael, Lt. R.E. (T.),

London, S.W., *February 9th*, 1917.

WAR ITEMS.

The Siemens Shares.—The Public Trustee is inviting tenders, which have to be delivered by April 2nd, for the whole or part of 119,660 shares of £5 each, fully paid, in Siemens Bros. & Co., Ltd. The issued capital is 120,000 shares of £5 each, fully paid. Particulars appear in our advertisement pages to-day.

Report on Trade After the War.—Lord Balfour of Burleigh's Committee, set up by the late Government to advise as to the best method of carrying out the resolutions of the Economic Conference of the Allies at Paris and of promoting British and Imperial trade after the war, has completed its report, which has been sent to the Prime Minister. The report is unanimous, and the recommendations are said to be very wide-reaching.—*Morning Post.*

The *Times* on Wednesday also stated that the report was unanimous, and that it would be found to "recommend the adoption of Imperial preference as the foundation on which should be reared our world economic policy of the future." The Committee includes men of every school of political and economic thought.

Leaving Certificate.—An electrical switchgear fitter, employed by a Rochdale controlled firm, applied to the Rochdale Munitions Tribunal for a leaving certificate, on health grounds. He produced two doctors' certificates, and his Trade Union secretary said the man's breakdown was due to the "unhealthy state of the works." The firm wrote that their works were as healthy as any in the district. The certificate was granted.

To be Wound Up.—The Board of Trade has ordered the following companies to be wound up under the Trading with the Enemy Amendment Act:—

Brimsdown Lamp Works, Ltd., Kingsway House, Kingsway, W.C., manufacturers and dealers in electric lamps and fixtures. Controller: H. J. Morland, 3, Frederick's Place, Old Jewry, London, E.C.

Coal Distillation Co., Middlesbrough, manufacturers of coke ovens and by-product plant. Controller: G. B. Nancarrow, Royal Exchange, Middlesbrough.

Exemption Applications.—When an appeal was made to the Middlesbrough Tribunal for the exemption of the electrician at the Opera House, the Military Representative remarked that the difficulty of finding a substitute was that the business was not regarded as of national importance. He was given until May 1st.

At Southport, Mr. A. S. Black, the borough electrical engineer, applied for the exemption of four men, who had been debadged. He said the Minister of Munitions said they could not be called up until substitutes had been found, and he had written for the latter. The Tribunal refused the appeal, but the men are not to be called up before substitutes are found.

Mr. Barr, the Swansea borough electrical engineer, has been requested to apply for the exemption of the switchboard attendant. The engineer stated that he had lost two of his men, one of whom had joined the Army, and the other, refusing to do so, left and got a similar appointment in an electrical works on the East Coast, where he obtained exemption from military service. What he (Mr. Barr) complained of was that his men were refused exemption at Swansea, but went elsewhere and got it. The works could only be carried on with great difficulty if the present attendant was called up.

At Northampton Tribunal, Dr. Rambaut, the medical superintendent of St. Andrew's Hospital for Mental Diseases, Northampton, appealed for the exemption of H. Heritage, aged 24, electrician at the branch hospital at Llanfairfechan. Dr. Rambaut said Heritage was quite a genius. He was responsible for the whole of the electric installation and machinery at Llanfairfechan. His duties included the working of the turbines when the water coming down from the hills was used. He was a Class A man, but the difficulty of obtaining labour was so great that it was practically impossible to find a substitute. The Tribunal gave exemption to March 31st, with leave to appeal again, but urged Dr. Rambaut to make endeavours in the meantime to obtain a substitute.

At the West Riding Appeals Tribunal, at Dewsbury, last week, the case of an electrical engineer and draughtsman, aged 24, who was given conditional exemption some little time ago, was heard. On that occasion it transpired that he had come from a good position in Spain to do national work in England, but considered he could be vastly more useful in such work than in the Army. The Military Representative now wanted the case to be reviewed. The young man, it was stated, had said on the first hearing that he had a fixed engagement with the Yorkshire Electric Power Co., and he (the Military Representative) challenged that statement at the time, and he now had a letter from the manager of the company stating that the position was only a temporary one. The appellant, in answer to a question, said he adhered to his statement that he had a fixed position. He denied that he had been offered a fixed position with another firm and had refused it, but said he had been offered a better paid job, but his employers refused a leaving certificate, saying he was in a certified occupation. In answer to the Chairman, the appellant said that when he went to the Yorkshire

Electric Power Co., he was told he would be on trial for a month, and was then to sign an agreement, and he would be subject to an advance in six months. He held that that was as fixed as any position could be. The Chairman said the view of the Tribunal was that if a man was employed in a certified occupation with a firm which was not Government controlled, he could leave at any time. The appellant: Do I understand that if the Yorkshire Electric Power Co. is not a controlled firm I can leave and take up this other job? The Chairman: Of course, we cannot advise you. The appellant said he had sacrificed a lot of money to come to England, and if he got the new job at better pay than he was now earning he would still be £3 a week worse off than he was in Spain. In answer to the suggestion of the Military Representative that the appellant had refused an offer by the Yorkshire Electric Power Co. of a fixed job, the latter said the offer was for him to sign a three years' agreement at his present salary, and he refused. The Chairman said that was quite another story, and he was entitled to refuse, and if the firm were not controlled the appellant could go to another engaged in work of national importance. The Tribunal decided to confirm its previous decision, and the conditional exemption was granted.

Before the Chertsey Rural Tribunal, the Military Representative asked for the withdrawal of a certificate of exemption held by Mr. G. W. R. Howard (37), of Pyrford, inspecting engineer to the Tudor Accumulator Co. Mr. Howard, it was stated, was responsible for the proper maintenance, under contract, of the company's storage batteries at military camps, forts, and hospitals, and in railway and munition works throughout the South of England. The Tribunal respited the appeal for inquiries.

An East Grinstead (Sussex) firm, appealing for their electrician, aged 38, stated that the man visited a large number of houses to keep the engines going for electric light, pumping, &c. He went round to run the engines, and had relieved about 20 men. Three months were allowed, with no new appeal without leave.

An appeal was made at Hereford by Mr. W. H. Preece (35), an electrician at the municipal electric light works. Exemption was refused, but appellant is not to be called up until an efficient substitute has been found.

At Clacton-on-Sea, Mr. H. W. Everitt, electrical engineer, appealed for further exemption for R. Cook (28), for whom he could not find a substitute. The man had the care and lubrication of two gas engines and a Diesel engine, and assisted with the electricity plant. The Tribunal granted six weeks' temporary exemption to find a substitute.

Before the Redruth Tribunal, Mr. L. A. Hards, manager for the Cornwall Electric Power Co., appealed for exemption for eight men, and stated that their pre-war staff of 220 was reduced to 160. Three of the men were refused exemption, two were conditionally exempted, two were given six months each, and the other until August 1st.

At the Sunderland Military Tribunal, the Military Representative applied for the review of conditional exemption certificates granted to two electricians in the employ of the Corporation. Mr. Blackman, borough electrical engineer, said that if the staff of the generating department was further weakened there might be the possibility that, through the temporary failure of the supply of current, thousands of men engaged on work of supreme national importance might be unable to continue their tasks. The Tribunal withdrew the certificate of the younger man, who had been passed for general service, and confirmed the exemption in the other case.

Grays Tribunal has granted temporary exemption until April 30th to Mr. C. Gooden, engineer at the U.D.C. electricity works.

At Winchester, before the Hants Appeal Court, the Military Representative appealed against conditional exemption allowed locally to an assistant meter tester, aged 25, and passed for general service, engaged at the Winchester Corporation electricity works. The Military Representative argued that the man was not necessary for the generation of electricity, and that meter testing did not come within the category of a certified occupation. As Chairman of the Electricity Committee, the Mayor said the question was not whether the undertaking would suffer, but whether the public would suffer. The service was a public one, and since the war the Committee had induced 13 of the men to join up. Two men now did the work of four, and two girls had been instructed in the technical work for 12 months, but without success. The conditional exemption was withdrawn, and a final two months substituted.

At Watford, on January 31st, Mr. A. W. Barham, electrical engineer to the U.D.C., appealed for two employés who had been debadged. L. Cook (26), coal trimmer, passed for active service, and H. Tomkins (30), engaged in the same work, and who is now in hospital. Mr. Barham said that he could not get other men. The Tribunal decided that Cook should join up on March 1st, and the other case was respited for a month. Mr. Barham remarked that it was possible that the munition authorities would say that Cook was not to go on the date fixed.

At Weston-super-Mare, the Electric Supply Co., Ltd., applied for conditional exemption for S. F. Saunders (37), fitter-driver at the generating station. Mr. G. Charlton, managing engineer, stated that the man was indispensable, and although he was a munitions volunteer, a Board of Trade inspector had declined to remove him from the works as they were already understaffed. Conditional exemption was allowed.

At Swindon, an appeal was made by the Swindon Engineering Co. for Mr. G. A. Smith, electrical engineer, managing director of the company. Counsel said that Mr. Smith had invested the whole of his life's savings in the concern, and upon him very largely depended the well-being and continuance of the business. They had carried out sub-contracts for munitions, mostly of an experimental character, and had been promised numerous contracts. The amount of capital involved was £10,000, and Mr. Smith was a specialist in electrical and hydraulic work. Two months were granted. Counsel gave notice of appeal.

Bath Tribunal, with the assent of the Military, granted three months' exemption each to W. Hayward (41), body builder; T. T. Tregaskis (37), driver; and E. W. Perry (37), painter, appealed for by the Bath Electric Tramways, Ltd.

BUSINESS NOTES.

Anglo-American Trade.—Arrangements have been made for establishing an American Chamber of Commerce in London. Particulars of membership may be obtained from Mr. J. Tuck Sherman, the secretary, at the temporary offices, 3, Lombard Street, E.C.

Sales of Shares.—The Public Trustee is inviting tenders for 82,406 £1 shares (10s. paid) and 81 £1 paid, in the British Railway Traffic and Electric Co., Ltd., also 2,250 £1 pref. and 2,500 £1 ordinary shares in the Yorkshire Copper Works, Ltd.

Patent Restoration.—An order has been made restoring Patent No. 23,979, of 1911, granted to Christopher Harvey for "Improved incandescent electric lamp and holder therefor."

Patents and Alien Enemies.—Application has been made to the Board of Trade by Messrs. Fredk. R. Butt & Co., Ltd., for the avoidance or suspension of Patent No. 25,101/12, granted to Bauer, for high-tension electrometers.

Bankruptcy Proceedings.—John Taylor Peddie, mechanical engineer, Exhibition Buildings, Aldwych Site, Strand, London.—The following amended notice is substituted in the *London Gazette* of February 9th for one that appeared there in February, 1916:—

To pay in full forthwith any preferential claims in priority to other debts, also all proper costs, charges, and expenses, together with the fees and percentages of and incident to the bankruptcy petition and this proposal. Also a composition of 5s. in the £ to all unsecured creditors in respect of debts provable under the receiving order herein payable, as provided by the scheme, such payment to be guaranteed to the Court's satisfaction. (The whole composition was paid down in cash to the trustee.) Four creditors have released their claims herein. Mr. Frederick Seymour Salaman, chartered accountant, 1-2, Bucklersbury, E.C., to be trustee hereunder at a remuneration of 2½ per cent. on the amount receivable by him under this scheme. Receiving order discharged. Adjudication annulled.

C. B. O'Gilvie, electrical engineer, 43, Dudley Road, Whalley Range.—The public examination of this debtor was fixed for February 6th, at Salford. The debtor's name was duly called, and when he did not put in an appearance at the end of 15 minutes, the Official Receiver suggested that as the non-appearance might be due to the inclement weather, the examination should be adjourned. The Registrar assented.

Catalogues and Lists.—"Cantie" Switch Co., Ltd., 67, Mount Street, Nottingham.—Illustrated descriptive list of "Cantie" patent fuse gear, with prices and code-words of boards for double and triple-pole circuits, 10 to 15 amperes per way.

Electrical Supplies Co., 233, Tottenham Court Road, London, W.C.—Priced leaflet of Hotpoint El Radio heaters.

Swedish General Electric Co., Ltd., 5, Chancery Lane, London, W.C.—January list of D.C.-type "K" motors and Century single-phase motors.

Enterprise Manufacturing Co. (Ashdown and Roberts), Gun Street Electrical Works, Bishopsgate Street, London, E.C.—Illustrated price circular of Beam convertible electric fires, electric irons, &c.

The Keighley Gas and Oil Engine Co., Ltd., of Imperial Works, Keighley, have sent us a block of date and engagement slips for 1917. The block is mounted on a stout base in the shape of one of their "Imperial" engines; it is made to stand on the desk or to hang.

Dissolutions and Liquidations.—Maschinenfabrik Augsburg-Nurnberg A.G.—The Controller, Mr. B. E. Mayhew, Alderman's House, Bishopsgate Street, E.C., has applied for his release.

Fazackerley & Co., plumbers, electricians, &c., Market Street, Droylsden.—Messrs. R. Fazackerley and J. E. Capper have dissolved partnership. Mr. Capper attends to debts, &c., and continues the business under the same name.

For Sale.—The Borough of Salford Electricity Department has for disposal a quantity of old-pattern electricity meters. The Walthamstow U.D.C. has for disposal four Dowson gas generators and auxiliaries, and one gas-holder. Full particulars are given in our advertisement pages to-day.

Spain.—A Barcelona firm, according to the British Consul there, states that it is almost impossible to obtain switches and other small electrical goods.

LIGHTING AND POWER NOTES.

Accrington.—Alderman Higham recently stated to the T.C. that now they had some spare plant at the electricity works the engineer was taking every opportunity of getting the plant into as good condition as possible, and steps were being taken with regard to the boring and lining of three cylinders, at a cost of £100 each, and the supply of one new spare top cylinder at £240. The new plant, he proceeded, was working most satisfactorily.

Ashtead.—Street Lighting.—The Leatherhead Electricity Co., in asking the Parish Council to pay the charges due in respect of public lighting, said it was prepared, when the lighting restrictions were removed, to enter into a contract for the lighting of the parish for one year at the same charge as previously, despite the advanced prices of labour and materials. It was decided to ask the company to make a reduction on the present account, as the Council had not the power to enter into a contract such as suggested.

Birmingham.—The report of Councillors Beale and Appleby on the recent failures of the electricity supply, has been submitted to the Lord Mayor; it is now being considered by the Electric Supply Committee, and, together with comments, will come before the City Council at its next meeting.—*Birmingham Daily Post.*

Bradford.—The Corporation is lodging formal objections to the Clayton and Queensbury Electric Lighting Order Bill and the Rawdon and Yeadon Electric Lighting Order Bill. In the former case, the town clerk reports that the Order will affect Bradford as regards tramways, gas, and water, as well as possible extension of boundaries, and in the latter case the Order affects the city only in regard to possible boundary extension. The objections are lodged to give the Corporation an opportunity to take future action as thought desirable, and the matter is left in the hands of the chairmen and deputy-chairmen of the Finance, Electric, Gas, and Water Committees.

Bradford-on-Avon.—The B. of T. has extended the electric lighting Order for one year.

Bristol.—Street Lighting.—As a result of certain experiments, it has been arranged to considerably increase the street lighting in certain throughfares where the lighting is under the control of the electrical department.

Burton-on-Trent.—Proposed Plant Extension.—The Electricity Committee has decided to approve a scheme of extensions at the electricity works. Application is to be made to the L.G.B. and the Treasury for sanction to borrow £25,000 for the plant, &c., required. During January, 427,803 units were sold for lighting, power, heating, &c., and 50,977 for traction, showing an increase of 93,651 units under the former head, and a decrease of 1,096 units for traction as compared with the corresponding period of last year. Two motors for driving in connection with the supply of power to the English Grains Co., Ltd., are to be purchased.

Derby.—Proposed Loan.—The T.C. has applied for sanction to a loan of £29,500 for the extension of the electric power station.

Gravesend.—The T.C. has decided to seal a petition against the West Kent Electric Power Bill, it being considered that the district between Gravesend and Dartford, covered by the Bill, should be reserved for Gravesend, and principally for the purpose of linking up with Dartford, if the scheme for doing so is ever carried out.

Liverpool.—Year's Accounts.—The electric supply accounts for the year ended December 31st last show a total income of £405,650, and a balance (gross profit) of £229,788). Of this amount interest absorbed £68,631, and sinking fund contributions £57,146, while £39,168 was transferred to renewals, and £65,000 contributed to rate relief. The renewals fund now amounts to £102,778, some £36,000 having been deducted during the year. The reserve fund stands at practically £180,000 while a fuel guarantee fund also figures at £5,388. No operating data is published with the accounts.

At the City Council meeting, last week, Mr. E. Russell-Taylor, the chairman of the Electricity Committee, said that the Corporation sold, last year, over 60,000,000 units. In 1912 it made a profit of £51,000; last year it almost doubled the amount, and gave £65,000 towards the relief of the rates.

London.—Battersea.—The Finance Committee reports, with reference to the extensions of mains, &c., in the Nine Elms district, that it has only been found necessary to apply, at present, for sanction to a loan of £1,000 (instead of £4,300) towards the cost of the work in question.

Morley.—Year's Working.—The accounts of the electricity department to March last, just issued, show an income of £3,901, and an expenditure of £4,514, the deficit on the year being £612, as compared with a deficit in 1915 of £301. The capital expenditure was £28,446, and the loans outstanding are £20,800.

Preston.—Mr. J. F. Simpson, the borough electrical engineer and tramways manager, has submitted to the Corporation Tramways Committee a report upon the supply of electricity for power purposes. At present the provision of electricity in the town and district, for both lighting and power, is controlled by the National Electric Supply Co., Ltd. It is pointed out in the report that the existing company produce a comparatively small amount of energy for power purposes, and that as a scheme to deal with the question on a sufficiently broad basis would involve the erection of a new power station, it is hardly to be expected that the company would sink the necessary capital, in view of the fact that its powers lapse in 17 years. A case is made out for the equipment of Preston with a plant in readiness to meet the growing industrial demand and the expected expansion of trade on the conclusion of the war, and it is suggested that the Corporation possesses an ideal site for a new generating station.

Queenstown.—It is understood that there will be a considerable extension of electric lighting in connection with the new shipbuilding yard which is to be established: it is said that the scheme will also include the Rushbrooke Docks.

Sheffield.—An application from the Electrical Trades Union for increased pay up to 49s. per week for wiremen, cable jointers, and skilled electrical workmen has been acceded to. The preparation of plans and specifications for the buildings and equipment of the new power house at Blackburn Meadows is to be proceeded with; one 10½-in. lathe and one screwing maching for the fitters' shop at the Neepsend power station are to be purchased at a price not to exceed £237.

Southwick.—The U.D.C. has decided to raise no objection to electricity for power being supplied by Brighton T.C. to a local firm, provided the Council's rights are properly safeguarded.

St. Helens.—The Electricity Committee has been considering the question of supplying electricity to the proposed electrolytic works which the United Alkali Co. contemplates erecting; provisional terms have been arranged, and it is hoped the new works will be secured for the borough.

Stockport.—Year's Working.—The accounts of the Corporation electricity undertaking for the year ending March 31st last show that over 15 million units were sold, and some 17½ million generated, the total plant capacity being 11,000 kw. The total revenue for the year was £50,010, of which £30,000 was derived from power supply; the gross profit was £18,576, and, after meeting interest and loan charges, an expenditure of £3,400 on works of a capital nature, and transferring £1,028 to reserve, a balance of £3,000 remained (which is scheduled as available for rate relief). The electricity reserve fund only amounts to £1,859, but some £6,977 has been spent out of revenue on capital account.

Extensions Held up.—At the last meeting of the Council attention was directed to a decision of the Government not to grant any facilities for the manufacture and installation of additional plant required by the electricity department. It was asserted that the plant was at present working at the top of its capacity, and it would be a serious matter for factories, the tramways, and the town generally if there was a breakdown. The chairman of the Electricity Committee said they intended to press for facilities for providing the plant.

Stretford.—Application for badges has been made for four employés at the electricity works, but the Ministry of Munitions informed the U.D.C. that it was unable to issue the necessary badges.

Swindon.—Plant Extensions.—The T.C. has decided to lay down additional plant to enable current to be supplied to a new factory in the town. The estimated cost is £6,000.

Torquay.—The T.C. has decided to accept the offer of the Tramway Co. to pay £250 towards the extra cost of coal for the period from August 1st, 1915, to July 31st, 1916, and 10 per cent. per unit additional on the rates for current set forth in the agreement from July 31st next. The company had declined to pay an extra ¼d. per unit as from August 1st, 1915.

United States.—Returns published in the *Electrical World* show that the central station output in 1916 amounted to 23,300 million kw.-hours, an increase of 23 per cent. over 1915, and the revenue from this source was 417 million dollars, an increase of 15 per cent. The total income of "service companies" was not less than 1,750 million dollars, and, with the revenue of manufacturing and other electrical companies together, made a total estimated at 2,500 millions. Income for electric traction service is estimated at 750 millions.

The Central Stations placed orders for 2,000,000 kw. of steam turbines and 400,000 kw. of water turbine plant.

In connection with the agitation for an increased diversion of water from Niagara, it is stated that plans and specifications have been prepared by the Niagara Falls Power Co. for modernising its plant, at a cost of $11,000,000, which will enable the company to develop 180,000 h.p., instead of 90,000 h.p. as at present. Additional transmissions will be constructed to Buffalo and into Central New York and Pennsylvania.

Warminster.—The B. of T. has extended the electric lighting Order for one year.

Worcester Park.—Proposed E.L.—From correspondence read at the last meeting of the Parish Council, it appeared that both the South Metropolitan Electric Tramways and Lighting Co. and the Wimbledon T.C. are anxious to supply electricity to the district. Wimbledon Corporation, however, only proposed to supply a part of the parish, whereas the South Metropolitan Co. would supply the whole of the parish. It was resolved by the Council to agree with the decision of the R.D.C., which was to support the application of the South Metropolitan Co., provided that satisafctory guarantees were given in the Act that the price to consumers should not exceed 6d. per unit.

TRAMWAY and RAILWAY NOTES.

Bacup.—The Mayor reported to the Town Council on the recent arbitration proceedings with Rawtenstall *re* fares, and Councillor Lord said that although Bacup had proved its case, it had to pay half the costs of the award. The only satisfaction it had was that a lot of money had been thrown away, and no one was any better for it, except the arbitrator.

Brighton.—Electric Vehicle.—The Corporation, on the recommendation of the Works Committee, has decided to purchase a 3½-ton electric battery vehicle and a 5-ton steam vehicle, each to have interchangeable bodies, to be used for watering and general haulage. The Committee estimates that these two vehicles will do the work of six horsed vehicles. The present cost for horse and driver is 11s. 4½d. per day. The estimated cost, including interest, depreciation, maintenance and wages, &c., is, for the steam vehicle, 23s. 8d. per day; for the electric vehicle, 27s. 7d. per day.

Bradford.—Mr. Greenside, of the Labour Regulation Department, has made his award in the dispute between the tramway department and its engineering employés. In sending a copy of the award to the Amalgamated Society of Engineers, Mr. Greenside stated that the action of the engineers in refusing to work overtime pending a settlement was not only illegal but unjustifiable in the national interests, and if the offer of arbitration had been accepted by them when made, the dispute could have been settled long ago.

Burnley.—Strong criticism was made at a meeting of the Council on the suspension of the late cars, but an amendment in favour of reconsideration was defeated.

A Sub-Committee of the Tramways Committee has been asked to report on the heavy increase in working expenses and the decrease in traffic receipts since the suspension of the late cars.

Continental.—Russia.—On December 17th (O.S.) a meeting of the Committee on New Railways was held to consider the question of constructing the Neva suburban tramways for Petrograd from the town boundaries to Voznesensk, a length of about 20 versts. Besides groups of contractors, the Petrograd district and Government zemstvos asked for the concession with a limitation of the tramways to the village of Ust-Izhor. The new Railways Committee, recognising the preferential claims generally of local public bodies, decided in favour of granting the right to construct the suburban tramways to the District Councils, giving preference again to the Council of the district most closely interested. For the purpose of the construction of the tramways as soon as possible, the Committee fixed the time to start work not later than May 1st (O.S.), 1917, and the date of completion to be not later than January 1st (O.S.), 1919.

Darwen.—Fare Increase.—The T.C. has decided upon an increase in the fares on the Corporation tramways; otherwise the tramways would have to make a further call upon the rates.

Doncaster.—The T.C. has referred back to the Tramways Committee for reconsideration a proposal to construct a double tramway line from St. Sepulchre Gate to Baxter Gate.

Dudley.—Tramway Accidents.—On Wednesday, last week, an adjourned inquest was held into the circumstances respecting the overturning of a car in Tipton Road on January 4th, by which the conductress, Annie Payne, was killed, and 26 persons were injured. The jury found that the accident was caused by the carelessness of the conductress in releasing the brake without convincing herself that she had received the proper signal to do so. They also expressed the opinion that the Tramway Co. was to blame for not having made some arrangement that would have prevented the accident.

On the same day two cars came into collision in a fog on the single line on the Dudley and Stourbridge route at Scotts Green, and a motorman, John Mogan, was killed. At the inquest it was stated that Morgan was responsible for the accident in leaving the loop, contrary to the regulations, which were to wait in the loop until the Stourbridge car had passed; also, that the conductresses should have acted as pilots. A verdict of "Accidental death" was returned.

Glasgow.—Finance.—It is recommended that the whole tramway debt be wiped off, and that no further sinking fund be provided except for further borrowings, and that there shall be a cancellation of all borrowing powers except for future extensions and additions to plant. In the course of a report by Mr. James Dalrymple, the general manager, it was stated that as the total amount of the accumulations of revenue invested with the Common Good now exceeded the amount of capital indebtedness, it was proposed to transfer from the depreciation and permanent way renewals fund to the sinking fund such a sum as would make the sinking fund equal to the capital expenditure. The total amount of capital expenditure was £3,835,156. The net amount owing to the Common Good was £2,328,889. The proposal was that this sum should be taken out of the depreciation and permanent way renewals investment account. The total sinking fund already applied in reduction of debt was £1,506,267, which, added to the £2,328,889, would make the total sinking fund £3,835,156, being the exact amount of the capital expenditure. The effect of this arrangement would be that the sinking fund would equal the capital expenditure, or, in other words, the whole of the debt would be wiped out, and there would remain a balance of £119,055 at the credit of depreciation and permanent way renewals fund.

Mr. Dalrymple pointed out that he thought it wise to add to this sum annually out of revenue. He suggested that the following sums might be set aside out of revenue to meet expenditure in renewals;—Permanent way, £39,600 (£200 per mile of single track); power station and sub-station plant, £13,827 (3 per cent.); cars and electrical equipment of cars, £16,755 (3 per cent.); other rolling stock, £2,790 (15 per cent.); and Clydebank bridges, £550 (5 per cent.)—a total of £73,522.

Halifax.—Proposed Fare Increase.—At the last meeting of the Council, the proposal of the Tramway Committee to increase the tramway fares by 50 per cent. was defeated by a large majority. Many meetings of protest had been held by business men as well as the workers' organisation. No arrangement has been come to with adjacent towns whose systems join up, and until such arrangement is made, nothing further can be done.

L. & Y. Railway Electric Services.—In the annual report of the directors of the Lancashire and Yorkshire Railway, it was stated that the electric train service on the Manchester and Bury line, which commenced running on April 17th last, had given every satisfaction, and that the change from steam to electric traction had been greatly appreciated by the public.

Liverpool.—Year's Working.—At the meeting of the City Council, last week, Mr. E. Russell-Taylor said that last year they made a greater profit on the tramways than prior to the war, notwithstanding that their expenditure had increased by £147,000, of which £50,000 represented increased wages and bonuses to the employés. They carried 157,636,595 passengers, 13,500 more than in the record year of 1913, including 4¾ million soldiers and sailors carried free of charge. Of their 2,700 employés, 1,900 had joined the Forces, and 100 had been killed.

London.—It is stated that every endeavour is being made to commence the through "Bakerloo" tube service between the Elephant and Castle and Watford on March 1st, and to this end the Central London and Piccadilly Companies are lending cars owing to the present shortage. The Ealing extension of the Central London line has been completed for steam trains, but shortage of equipment prevents its electrification.

Manchester.—Traffic Congestion Report.—The report of the Select Committee of the Corporation appointed to deal with the problem of traffic congestion in the city deals exclusively with the problems of tramway transportation, and a sweeping scheme of reform is suggested. The report suggests the use of a portion of the old infirmary site, in Piccadilly, as a tram terminus, the erection of general tramway offices on another portion, and the acquisition of the whole of the open spaces and squares in the city for tramway terminals. The construction of six great arteries and the cutting of new streets is also recommended, as well as that there should be a limitation of tramway traffic within a certain prescribed area in the centre of the city.

Preston.—Year's Working.—The annual report of the Corporation tramways department shows that the total revenue amounted to £51,332, or an increase over the previous 12 months of £3,557, the passengers having increased from 10,761,381 to 11,631,232. The working expenses and war service allowance amounted to £31,201. The gross profit was £20,130, and after deducting financial charges there was a balance to be carried forward of £3,697. The reserve fund had been increased to £47,309.

Rotherham.—Purchase of Cars.—The Tramways Committee proposes to purchase 10 second-hand cars to relieve the present pressure on all routes.

Salford.—Fare Increase.—The T.C. has decided to increase the fares on the Corporation tramways, which are now paying £32,032 per year in increased wages, war bonuses, and allowances to dependents of employés on active service, and, in addition, meeting many other higher charges.

Sheffield.—Purchase of Cars, &c.—Owing to the curtailment of the railway services, there is need for additional cars on the Sheffield and Rotherham through service at certain periods of the day; a meeting is to be arranged with the Rotherham Tramways Committee on the question of a more frequent service. In view of the fact that the Ministry of Munitions has not granted a permit for the purchase of 25 new tramcars, the offer of the L.C.C. to sell 10 four-wheel double-deck cars is to be accepted. The Tramways Committee has confirmed the action of the city surveyor in purchasing 75 tons of rails from the Brighton Corporation. The cost of constructing car top covers required for the converted single-decked cars, the construction of which is being continued in the department workshops, is to be met out of revenue.

Stockton-on-Tees.—Proposed Tramway Purchase.—The T.C. has decided to discuss at a special meeting the question for purchasing the tramway undertaking in conjunction with the Thornaby and Middlesbrough Corporations.

Stretford.—The B. of T. has extended for a further year the time in respect of the tramways and works referred to in Sec. 31 of the Manchester Corporation Act, 1911, excepting a portion of tramway in the U.D.C. of Cheadle and Gatley authorised by the Manchester Southern Tramways Act, 1903. The U.D.C. has decided to oppose the renewed application to the Light Railway Commissioners by the promoters of the Lostock Light Railways Order.

U.S.A.—The Illinois Central Railway has submitted to the Chicago Railway Terminal Commission a comprehensive plan for reconstructing the lake front passenger terminal, and including the electrification of its suburban passenger service within five years.

The Traction and Subway Commission has made public a portion of its report on the improvement of transportation in the city, which will involve an estimated cost of $260,000,000, for which 58 miles of subway and 525 miles of surface lines can be built (single-track mileage being reckoned).

Walsall.—With a view to urgent repairs being carried out at the generating station, the tramway service was shut down on three days between 9 a.m. and 8 p.m. The increased price to be paid for energy will involve an additional expenditure by the tramway department of about £1,000 per annum.

Wolverhampton.—In order to resume the 'bus service to Penn, it is proposed to purchase two Tilling-Stevens petrol-electric chassis and suitable bodies, at an estimated cost of £1,016 each, also a second-hand Albion 'bus.

TELEGRAPH and TELEPHONE NOTES.

Brazil.—A wireless station has been discovered five miles from Rio de Janeiro, at Nictheroy. It is stated that it was established to communicate with the German ships detained in the harbour.

Spain.—A decree has been issued placing all wireless telegraph stations in Spain under official supervision, and henceforth they will be worked under State control.

CONTRACTS OPEN and CLOSED.

OPEN.

Aberdare.—March 7th. Powell-Duffryn Steam Coal Co. Electrical goods for 12 months. Stores Manager, Aberaman Offices, Aberdare.

Australia.—SYDNEY.—March 5th. Council. One 7,500-K.V.A. turbo-alternator. See "Official Notices" January 5th.

ADELAIDE.—March 28th. P.M.G.'s Department. Telephones, telephone parts, line and battery material, &c. Schedules 444 to 453. See "Official Notices" February 2nd.

MELBOURNE.—March 21st. Victorian Railways. 200 half-watt lamps and 100 lanterns; also 100 contact couplings.* April 4th. Terminal blocks (complete) for electrical connections.—*Australian Mining Standard.*

March 7th. Council. 1,048 electricity recording meters. See "Official Notices" February 9th.

BRISBANE.—March 28th. P.M.G.'s Department. Cable (switchboard), Schedule 394.

Argentina.—BUENOS AIRES.—March 30th. Electric carbons during 1917, for the municipality. Local representation. Conditions from Oficina de Licitaciones, Intendencia Municipal de la Capital, Avenida de Mayo 525, Buenos Aires.—*B. of T. Journal.*

Barrow.—March 5th. Corporation. Electrical stores for 12 months. Borough Electrical Engineer.

Bolton.—March 7th. Electricity Committee. Materials and stores. See "Official Notices" to-day.

Canada.—March 28th. Toronto Electric Commissioners. Synchronous condensers, 5,000, 7,500 or 10,000 K.V.A. capacity. See "Official Notices" February 9th.

Grenada.—March 31st. The time for tendering for the Government electric light and power concession, already announced, has been extended to March 31st.

Harrogate.—March 5th. Corporation. By-product steam boiler plant. See "Official Notices" February 2nd.

Kilmallock.—March 5th. Kilmallock (Co. Limerick) E.L. & P. Co., Ltd. Hydraulic turbine, dynamo and motor booster, battery, switchboard. See "Official Notices" to-day.

London.—BERMONDSEY.—February 22nd. B. of G. Electric lamps. Mr. E. Pitts Fenton, Clerk, 283, Tooley Street, S.E.

HAMMERSMITH.—February 28th. B.C. Electricity stores for 12 months. See "Official Notices" to-day.

METROPOLITAN WATER BOARD.—March 8th. Twelve months' supply of electric lamps. Chief Engineer, Savoy Court, Strand, W.C.

Londonderry.—March 17th. Corporation. Engine-room stores, carbons, electricity meters, cables, &c., for the Electricity Department. Town Clerk.

Macclesfield.—March 14th. Cheshire County Asylum. Electrical goods for one year. Mr. W. G. F. Tingay, Clerk to the Asylum, Parkside.

Manchester.—March 7th. Electricity Committee. Coal-conveying plant and suction ash plant. See "Official Notices" February 9th.

Spain.—Tenders have lately been invited by the municipal authorities of Finisterre (Province of Coruna) for the concession for the electric lighting of the town during a period of six years.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Department in London.

CLOSED.

Basingstoke.—In consequence of the enormous increase in the cost of crude oil for the Diesel engines at the electric generating station, the Council has accepted the tender of Messrs. Cole, Marchent & Morley, at £450, for converting the three engines so that tar-oil may be used. The difference in the present prices of the two oils is about £4 per ton, which on a year's consumption is estimated to effect a saving of from £400 to £460, after paying the cost of converting the engines. A tender for 200 tons of tar-oil, at not exceeding 90s. per ton, has been accepted.

Bridlington.—T.C. 200 tons of Pope & Pearson's washed small coal from the Normanton Pit, for the electricity works: Provincial Coal Supply Co., Ltd., £1 1s. per ton.

Glasgow.—T.C. Electric lighting of two shops in Gallowgate: Messrs. Smith & Stevenson, £41. Cable for the Tramways Committee: Liverpool Electric Cable Co.

Sheffield.—Corporation. Accepted tenders:—

Electric Construction Co., Ltd.—Direct-current traction switchboard, converter, and feeder panels, for Newhall Road sub-station.
A. Reyrolle & Co., Ltd.—H.T., 3,000-volt loose sub-station switchgear.
H. C. Hornbuckle.—Erection of sub-station, Newhall Road.
Mortimore, Lyon & Co.—Generating set and condenser for charging electric vehicles, £810.

Sunderland.—T.C. Tenders accepted:—

Babcock & Wilcox, Ltd.—Boiler stanchion.
British Mannesmann Tube Co., Ltd.—Boiler tubes.
Ferranti, Ltd.—E.H.T. switchgear.
Thos. Ness, Ltd.—Pitch and creosote oil.

Wolverhampton.—Corporation Electricity Committee:—

Reyrolle & Co.—Two switch panels, with instruments, transformers, &c., £670.
Staveley Iron Co.—Large c.i. pipes, £750.

FORTHCOMING EVENTS.

Institution of Mechanical Engineers.—Friday, February 16th. At 6 p.m. At the Institution of Civil Engineers, Great George Street, S.W. Annual general meeting. Paper on "Alternating Stress Experiments," by Mr. W. Mason.

Greenock Electrical Society.—Saturday, February 17th. Visit to Dellingburn power station. (Members to meet at 2.30 p.m.)

Thursday, February 22nd. At 7.45 p.m. At 22 West Stewart Street. Paper on "Electricity Supply Costs," by Mr. F. H. Whysall.

Association of Mining Electrical Engineers.—Saturday, February 17th. At 4.30 p.m. At the Royal Technical College, Glasgow. Paper on "Electrical Converters," by Mr. C. S. Buyers.

Saturday, February 17th. At 3 30 p.m. At the Midland Hotel, Mansfield. Paper on "The Steam Turbine and its Industrial Application," by Mr. P. J. Plevin.

Illuminating Engineering Society.—Tuesday, February 20th. At 5 p.m. At the Royal Society of Arts, John Street, Adelphi, W.C. Paper on "The Effect on the Eye of Varying Degrees of Brightness and Contrast," by Dr. James Kerr.

Institution of Civil Engineers.—Tuesday, February 20th. At 5.30 p.m. At Great George Street, S.W. Paper on "The Commercial Metering of Air, Gas and Steam," by Mr. J. L. Hodgson.

Institution of Electrical Engineers.—Wednesday, February 21st. At 7 p.m. At the University, Edmund Street. Discussion on "Fuel Economy."

(Scottish Local Section).—Friday, February 16th. At 7.30 p.m. At 207, Bath Street, Glasgow. Eighth Kelvin Lecture, "Some Aspects of Lord Kelvin's Life and Work," by Dr. A. Russell.

(Yorkshire Local Section).—Wednesday, February 21st. At 7 p.m. At the Philosophical Hall, Leeds. Paper on "Some Points in connection with Engineering Specifications," by Mr. J. Shepherd.

Liverpool Engineering Society.—Wednesday, February 21st. At the Royal Institution, Colquitt Street. Discussion on "The Gladstone Dock."

ELECTRICAL DEVELOPMENTS AT PERTH, W.A.

RECENT issues of the *West Australian* contained a lengthy description of the new East Perth power station and E.H.T. electrical distribution system, which, as mentioned in our issue of Jan. 26th, has been partly brought into use. As our readers are aware, the scheme has been carried out by the W.A. Government, which has entered into various agreements, and notably with the Perth and Fremantle authorities for the supply of energy at cheap rates.

The power station, which is situated on the banks of the Swan River, was commenced in June, 1914, and placed in partial operation on December 3rd last, the constructional work having been seriously delayed owing to shipping difficulties. When completed the plant will have a capacity of 12,000 KW., but space will be available for another 4,000-KW. unit, which it is expected will meet all requirements for some years, including suburban railway electrification.

The buildings are of steel and concrete, standing on a concrete raft foundation supported by piles. The coal is brought in by railway, automatically weighed and elevated, and conveyed to 300-ton bunkers over the boilers; the ashes are discharged by a suction-ash plant. Six marine-type Babcock boilers, with economisers, superheaters, and chain-grate stokers, are installed; the boilers supply steam at 210 lb. per sq.-in. pressure, superheated to 600° F., and each has a normal rating of 20,000 lb. steam an hour.

Each turbine is supplied with steam from a plant unit consisting of two boilers, two economisers, with an induced draught plant, chimney, and feed pump. Each turbine unit consists of a 4,000-KW. set, supplying 40-cycle, three-phase energy at 6,000 volts pressure and running at a speed of 2,400 R.P.M.; all the turbine auxiliaries are operated from a transformer, supplied direct from the alternator, thus ensuring their operation should the machine oil switch trip. An alternative interlocked supply is also provided from the main bus-bars.

Two motor-generators and two batteries supply energy for the electrical control of the switchgear and for lighting. The surface condensers are supplied with river water by vertical-type circulating pumps; the air pumps are of the three-throw type driven by geared induction motors.

The generators are equipped with forced ventilation, through cloth filters, the air being discharged outside the building. The oil switchgear is installed in a special switch-room, and is of cubicle construction; Merz-Price balanced protective gear is fitted to the generators, and the Merz-Hunter split conductor system has been adopted for trunk feeder work.

The local tramways are supplied through self-synchronising rotary converters giving 600 volts direct-current; two 1,200-KW. machines are installed at the tramway sub-station, and two similar sized machines at the power station.

It is stated that the expenditure on the power house to date has been £274,000, which will rise to £320,000 on completion; the expenditure on the ring main which supplies the sub-stations erected by the Perth City Council is stated to be £23,000; the total approximate cost of the scheme to the City Council is £162,878; the estimated total Government expenditure upon the whole scheme from Fremantle to Midland Junction, including power house, sub-stations and transmission, is £375,000.

A sub-station is provided adjacent to the power station, in which energy from the latter is stepped up from 6,000 to 20,000 volts pressure for transmission to Midland Junction and Fremantle.

The transmission line was erected by the tramway department, and is in duplicate throughout; it supplies step-down sub-stations at Midland Junction workshops, Ways and Works Department, Midland Junction Council's station, Guildford Council's station, West Guildford Roads Board's station, and Messrs. Cumming, Smith & Co.'s works at West Guildford. The transmission consists of copper wires carried on Jarrah A type poles; each line is rated at 2,500 KW. A similar line is being constructed to Fremantle by way of Victoria Park and South Perth to the port; it will also supply the Naval Base at Cockburn Sound.

The Perth Council's four sub-stations and the tramway sub-station are supplied through a three-core paper-insulated and armoured ring main; the Murray Street sub-station serving the city proper, is the largest, and contains four 500-K.V.A. transformers giving a supply at 440 volts for power and 250 volts for lighting. The area covered by the City Council's supply is divided into 26 sections for distribution purposes. The Wellington Street sub-station has a capacity of 1,000 K.V.A., Colin Street and Palmerston Street, each 400 K.V.A., and a fifth sub-station of 200 K.V.A. has just been erected at Maylands. The total cost of the five sub-stations has been £17,230.

The Council's agreement with the Government provides for supply within a 5-mile radius of the G.P.O., the Government reserving to itself the right to supply tramways and railways. The Government is to supply energy to the Council at the cost of production, but not exceeding 75d. per unit, and the Council will add the necessary capital charges, &c. Most of the consumers in the radius have undertaken to take energy, but several of the municipalities, including Subiaco and South Perth, are standing out. The consulting engineers to the scheme are Messrs. Merz and McLellan, who have been represented by Mr. C. T. Briggs, while Mr. W. T. Taylor is acting as Superintendent for the Government.

It is believed by those in charge that under the arrangements entered into an output of 16 million units will be sold in the first year of complete operation, and that the undertaking will prove more than self-supporting.

The contractors for the buildings and boilers were Messrs. Babcock & Wilcox; for the turbine plant and condensers, Messrs. Willans and Robinson; for the switchgear, transformers, and rotaries, the British Westinghouse Co.; and for cable and line material, Messrs Callenders.

NOTES.

Compound for Use in Building Dry Batteries.—The war in Europe has caused a scarcity of various articles once available in large quantities, and much effort and ingenuity has been exerted by all the warring nations toward finding substitutes for one thing and another. It had been the custom abroad until almost a year ago to use wheat or rye flour for thickening the electrolyte of dry batteries, but since there is now rather a scarcity of these cereals attention has been turned to other substances. Of these, kieselguhr, water-glass, gelatine, starch, sawdust, and glass-wool seem to have proved satisfactory. One of these products, or an admixture of several of them, is used as the base or binder. For the electrolyte proper is used well-powdered salammoniac, calcium acetate, zinc chloride, and thin refined glycerine in the proportion of about equal parts of salammoniac and calcium acetate, 80 grammes of each, 40 grammes of zinc chloride, and 10 grammes of glycerine. The mixture is stirred energetically after being covered with distilled water at a temperature of 40° C., and until all solid matter is dissolved and thoroughly mixed in one concentrated solution, which is then allowed to be taken up by the binder, forming a paste which is then applied between the plates of the cell or battery to form the electrolyte. The whole is enclosed in a casing of paraffin fitted with vents for the escape of gas. The addition of equal parts of calcium acetate and salammoniac is said to make a very satisfactory mixture, one which has high conductivity and does not crystallise, nor is it hygroscopic.—*Electrical World.*

Employers and the Future of Industry.—In the report of their proceedings during the past year, the Employers' Parliamentary Council express the opinion that when the time comes for taking stock of the nation's industrial resources, in view of the universal competition which will rule the markets of the world, it will be found that any return, even on a small scale, to the conditions which governed national production in the period before the war would be disastrous, and possibly fatal, to British interests both at home and abroad. It may, say the Council, be assumed as extremely unlikely that the systematic restriction of output which prevailed before the war, and is, unhappily, still existent, will ever again find favour in this country outside the ranks of the Labour Unions.

The Council note evidence on every hand of the growing feeling of distrust in the old methods of Labour Unionism. The fact of those methods having to be abandoned to meet national necessities has impressed itself strongly even on the minds of those who formerly excused them as promoting the interests of Labour. While it is only natural that such a body as the Trade Union Congress should formally reiterate its demand that pre-war conditions should be resumed, in accordance with the guarantees given by the Government, when it was found essential that those conditions should be set aside for war purposes, it may be noted that, so far, no reasons have been advanced for reverting to the evil practices which the pressure of direful circumstances caused to be discontinued, but a multitude of reasons—most of them obvious and incontrovertible—have been put forward in favour of saner regulations with respect to labour and industry, which it will soon become of vital importance that all classes concerned should strictly observe. The demand that after the war labour shall take a larger share of the profits of industry, a demand that has been endorsed by several members of the Government, and with which sympathy has been expressed in many influential quarters, is, in the opinion of the Council, one to which no reasonable exception can be taken, provided that Labour, earnestly and wholeheartedly, performs its part in the general scheme of production, and thus establishes a good title to the claim for greater remuneration. A high standard of production can be maintained only if the energies of Capital and Labour alike are exerted to their utmost capacity. Whatever the conditions under which various industries are conducted in the future, whether systems of co-partnership, or profit-sharing, or wages, the effort everywhere will have to be of a generally sympathetic and high-spirited character if all concerned are to benefit in the shape of increased gains.

Explosion Due to Static Electricity.—A *Daily Express* dispatch from Annapolis states that electricity generated by the friction of a fur coat worn by Surgeon Raymond Spear, of the United States Navy, "grounded" through a motor-car standing on wet ground, and caused a spark which exploded the petrol. Surgeon Spear was severely burned, and the vehicle was destroyed. It is explained that the surgeon had walked to his garage while wearing his fur coat and rubber boots. The flapping of the coat against his legs furnished sufficient friction to generate the electricity, while his boots insulated him from the ground and allowed his body to store it. When he approached the motor-car a spark was made which brought about the explosion.

Vienna Tramways.—Owing to lack of coal the tramway service in Vienna has been stopped for the present between 9 a.m. and 5 p.m.—*Times.*

Volunteer Notes.—First London Engineer Volunteers.—Headquarters, Balderton Street, Oxford Street, W.—Orders for the week, by Lieut.-Col. C. B. Clay, V.D., Commanding :—

Monday, February 19th.—Technical for Platoon No. 9, at Regency Street. Squad and Platoon Drill, Platoon No. 10. Signalling Class. Recruits' Drill, 6.30—8.

Wednesday, February 21st.—Instructional Class, 6.15. Platoon Drill, Platoon No. 1.

Thursday, February 22nd.—Platoon Drill, Platoon No. 7. Ambulance Class by M.O., 6.30.

Friday, February 23rd.—Technical for Platoon No. 10, Regency Street. Squad and Platoon Drill, No. 9. Signalling Class. Recruits' Drill, 6.25—8.25.

Saturday, February 24th.—N.C.O.'s Class, 2.30, under Company-Commander Fleming.

Entrenching.—Suspended until further orders.

Telephone Number.—The Telephone at Headquarters is now *Mayfair 1969.*

(By order), Macleod Yearsley, *Adjutant.*

Tramway Rails.—The following statement appears in the February issue of the *Journal* of the Tramways and Light Railways Association :—

"A small Sub-Committee was formed in 1915 with the object of providing tramway rails to those members who were in urgent need of same. Negotiations took place with a Committee of Manufacturers, and members were circularised in order to ascertain the quantities required.

"Applications for nearly 3,000 tons were received, but subsequently, owing to the prices quoted, several of these decided to withdraw. It was then found that the net amount remaining was not sufficient to induce the Committee to approach the Ministry. The manufacturers of special work, Messrs. Edgar Allen & Co., Ltd., and Messrs. Hadfield's, Ltd., were applied to, and with their help they were able to assist members to the extent of 580 tons—211 tons BS No. 1, 1c, 2, 2c ; 135 tons No. 4, 4c ; 234 tons No. 5, 5c. Stocks are now exhausted, but if any of our members should have a surplus of rails and will let the secretary know it would materially help other members with their shortage."

The Brittleness Produced in Steel Springs by Electroplating.—Messrs. M. DeKay Thompson and C. N. Richardson have investigated the fact that small steel springs become brittle when plated in copper cyanide baths. Plating in a nickel bath containing no cyanide had no such effect.

Though the explanation of the brittleness produced in a spring wire when used as a cathode in a hot cyanide solution could not be found, the following results were obtained :—

Spring steel becomes brittle when used as cathode in a hot cyanide solution, either sodium cuprocyanide or simply sodium cyanide. The effect is more pronounced with the simple salt. Brass and phosphor-bronze are not affected. Brittleness is not produced by the liberation of hydrogen on the steel. The carbon content is not changed by the electrolysis. The crystalline structure is not changed by electrolysis. The brittleness is not produced in annealed wire ; the brittleness is produced by use as cathode whether the wire is coiled, or not bent in any way. The brittleness is not produced when the wire is used as anode, or when it is suspended in the solution without the passage of electricity.—*Met. and Chem. Engineering.*

Electrometallurgy in the U.S.A. in 1916.—The installations of electric steel furnaces in the United States approximately doubled in 1915 and continued at an almost undiminished rate in 1916. The chief trouble met with is a lack of experienced operating men. High-speed tool steel is now being manufactured in 6-ton heats as a regular procedure, in contrast with the 100-lb. pour of the crucible. The heavy demand for high-speed tool steel and the difficulty of securing crucibles at any price have made the electric steel furnace an economic necessity.

A considerable number of electric furnaces have been installed in foundries for the manufacture of steel castings. More installations are contemplated involving the use of the electric furnace in a duplex process with the open-hearth furnace or the converter. Several electric furnaces are melting ferro-manganese before addition to steel.

In Germany—formeriy the largest producer of electric-furnace steel—the heavy demand for tool steel has also resulted in an increased use of the electric furnace for steel making. In August the production reached 17,000 tons per month, or six times teh monthly production at the outbreak of the war. On the other hand, the production of crucible steel has remained stationary. The monthly production of electric-furnace steel in Germany is now double the crucible output.

On a smaller scale there has been a heavy increase of ferro-alloy manufacture in the United States. Three new manufacturers of ferro-silicon started production during the year. At the outbreak of the war about half of the domestic ferro-silicon consumption was imported, but now practically all ferro-silicon needed for consumption is manufactured there, and a small amount is being exported. To provide part of the needed furnace capacity a calcium carbide plant in Niagara was switched over to ferro-silicon manufacture. During the period in question the domestic consumption of ferro-silicon doubled, and is estimated at 45,000 tons annually.

The largest domestic producer of ferro-chrome was able to supply the increased needs of the steel industry. With other alloys, such as ferro-tungsten, ferro-vanadium, ferro-titanium, and ferro-molybdenum there has been an increase of production, and several plants have been established. There is now sufficient plant capacity in the country for filling all domestic requirements of ferro-tungsten, and for the first time considerable quantities of ferro-tungsten are being exported. Exports of ferro-vanadium have doubled since 1915. Most of the new producers are using the electric furnace. Ferro-titanium is produced at Niagara to the limits of plant capacity, and the demand is greater than the power supply. A fair quantity of ferro-molybdenum is being manufactured in the United States, and towards the end of the year there was a marked increase in demand for foreign shipment, believed to have to do with the lining of big guns. Ferro-uranium was produced commercially for the first time in the U.S.A., and may be added to the new products of the electric furnace.

Aluminium manufacture in the United States enjoyed in the past year undoubtedly the maximum production and maximum prosperity in its history.

As a result of operations started in 1915 several plants are producing on a small but commercial scale by electrolysis very pure metallic magnesium.

Among new electrometallurgical enterprises electrolytic zinc looms large. There is the electrolytic zinc plant of the Anaconda Copper Co. at Great Falls, Montana, with a production of 100 tons of electrolytic zinc per day, while as a result of the Bully Hill experiments of the General Electric Co. a $350,000 electrolytic zinc plant is being erected at the Mammoth smelter in California.

The electrolytic copper refineries that were hit so hard at the start of the war have all been working to the limit of their capacity. Electrolytic refining has also made a success with tin.—*Met. and Chem. Engineering.*

The 1886 Company: a Long Arm.—A note from Moscow says that the Governor (N. V. Chelnokoff) of Moscow has returned from Petrograd, where he attended a sitting of the Committee for Combating German Predominance, at which a project for the liquidation of the 1886 Company was submitted, according to which it was proposed to form a new company to take the place of the Electric Lighting 1886 Company. Forty per cent. of the shares would be transferred to the Treasury ; 30 per cent. to the Moscow and Petrograd Town Councils ; the balance to be left with the present shareholders, subjects of Neutral Powers. The whole concern, Moscow and Petrograd, is valued at 55,000,000 roubles. A subsequent advice is as follows :—

At a recent sitting of the Moscow Town Council, a member (M. Mazing) explained how the Ministry of Trade and Industry granted a 4,000,000 R. subsidy to the 1886 Company. The *Ruzkiya Viedomosti* recounts his statement as follows :—Recently it has been shown that the company required 6,000,000 roubles to carry on its business. The company explained that failing such a grant, Moscow would be left without current for both lighting and industrial purposes. Previous to the beginning of the war, all the money at the disposal of the company was sent to Berlin. There remained only a few hundred thousand roubles, which were distributed for various purposes by the manager. It appears that the banks will not give the company money. The position of the company is such that it is impossible to say to whom the money may be given on credit, and from whom one may expect to receive it, for a continuous change in the position of the company is taking place. When it was shown that the banks would not advance money, the president of the board of the company, General Tzventorzhitsky, proposed to ask for it from the Ministry of Trade and Industry. The representative of the Ministry of Finance, Kukelbeker, supported the proposition. This support was sufficient for the presentation of the request. The representative of the Moscow Town Government desired to take part in the preparation of the memorandum, but he was informed that the board had sufficient grounds for the success of the application, and did not require any co-operation by a representative of Moscow. The grounds appeared to be quite sufficient, and the request was acceded to, though for a lesser sum. The Minister of Trade decided to grant the company a 4,000,000 roubles subsidy. This sum will, of course, be of great assistance to the company.

Information on the allocation by the Council of Ministers to the 1886 Company of a 4,000,000 roubles loan has produced a great impression in the Town Council, says the *Novoie Vremya*. It was hoped in the Council that the financial difficulties experienced by the company would hasten the decision on the point of liquidation. The President of the town made a detailed report to the Town Governor on the discussion that took place on the subject at the last meeting of the Special Executive Council, when N. I. Sushkin said that the former Minister of Trade and Industry, V. I. Timiryazeff, having strong relations with the banks, had decisively stated that the company would not obtain credit before the decision of the question of liquidation ; and, on the contrary, a large credit would be opened on the transfer of the concern into the hands of the town. After this report was read, the Town Governor immediately sent detailed reports to the Minister of Trade and Industry, Prince Shachovsky, and to the President of the Committee for Coping with the German Predominance, Stishinsky. In these reports Mr. N. V. Chelnokoff recalls the opinion of V. I. Timiryazeff, and asks for the speeding-up of the decision to liquidate. But apparently the Special Council of the 1886 Company has a long arm in the Petrograd administration, since the question of a loan was decided in a couple of days. At a later sitting of the Town Council on this question, a protest will probably be registered against such Government support of a German concern.

Appointments Vacant.—Several station engineers for 40-80-kw. oil-driven electric power stations in Lincolnshire for the War Department—Northern Command (50s. to 60s.) ; cost clerk (male or female) and shift engineer (50s.) for the Walsall Borough Electricity Department. See our advertisement pages to-day.

Late Legal.—Blundell *v.* Comins.—In the Court of Appeal, Lords Justices Swinfen Eady and Bankes, and Mr. Justice Lush heard an appeal by Mr. C. J. Weld Blundell from the verdict and judgment given against him in a libel action brought by Mr. Comins, of Chas. Comins & Co., chartered accountants, of London.

Mr. Parfitt, K.C., for the appealing defendant, said that Comins had been for about four years auditor of the Float Electric Co., and as such he made a monthly statement for the information of Mr. Weld Blundell, who really was the company, and had put large sums of money into it. £500 damages had been awarded to Mr. Comins in respect of a letter which had also formed the subject of an action by Mr. Lowe, a former manager of the company. In reply to a question by Lord Justice Swinfen Eady, Counsel said that the grounds of the appeal were that the damages were excessive, and that there was misdirection on the part of the Judge in omitting to direct the jury that the defendant ought not to be responsible for any injury to the plaintiff's reputation by the dropping of the letter and its consequent publication.

Without calling on the respondent, the Court dismissed the appeal.

Lord Justice Swinfen Eady said the letter complained of was a serious libel. It imputed misconduct to a professional man in his profession. True, the defendant's communication was to his own professional adviser, and it might be that the plaintiff never even heard of it. Certainly, it was not a communication made and intended to be communicated to the plaintiff. But, on the other hand, the damages could not be restricted to such pecuniary loss as the plaintiff could establish that he suffered. The damages were at large. That being so, could it be said that £500 was so excessive in amount that the jury must have been under some wrong impression, or acted on some wrong principle? He thought not. It was not for the Court to say whether the amount was such as they would have awarded.

Lord Justice Bankes agreed with regret. (1) Because the language used by the defendant was so absurd that very little importance would be attached to it, especially by those who knew the defendant; (2) because the tendency of juries at present was to award extravagant damages in libel actions.

Mr. Justice Bray concurred.

The appeal was therefore dismissed.

Institution and Lecture Notes.—Royal Society of Arts.—In the programme of forthcoming arrangements, is a fixture for March 7th, at 4.30 p.m, when Mr. J. H. Vickery, LL.B., will lecture on "German Business Methods."

Institution of Electrical Engineers.—The Council of the Institution has contributed £500 towards the cost of translation of the specifications of the Engineering Standards Committee into foreign languages.

The Council is also purchasing £5,250 new War Loan and the Benevolent Fund £700, these amounts being in addition to any amounts that may be transferred.

An alteration in the programme of the Scottish Local Section for the session provides for an Edinburgh meeting of the Section on March 20th, to hear a paper by Mr. G. A. Juhlin on "Voltage Regulation of Rotary Converters."

Association of Municipal Electrical Engineers.—The list of members of this Association now includes nearly every municipal electrical engineer in the country. No congress was held last year, owing to the president and other members being away on active service. It is hoped, however, to hold a congress this year, either at Cape Town or Durban, for which the following papers have been provisionally accepted :—

1. "Tariffs," by Mr. John Roberts, Durban. (Further discussion and consideration of paper printed in *Proceedings*.)
2. "Standardisation," joint paper by Mr. John Roberts, Durban, and Mr. B. Sankey, Port Elizabeth.
3. "Gas Plant," by Mr. F. Castle, Oudtshoorn.
4. "Design and Management of Small Power Installations," by Mr. E. J. Hamlin, Stellenbosch.

The Association has had under consideration for some time past the subject of standardisation in relation to sizes of plant, mains, material and supply pressures, and the same subject is now under consideration by the S.A. Institution of Electrical Engineers. It is agreed by all parties that the standardisation of rules and regulations of supply and the other items mentioned would be of immense advantage to all concerned, by enabling manufacturers to carry stocks in South Africa of practically all kinds of apparatus required with a minimum of outlay. It is not the intention of the Association to depart from existing British standards, but rather to choose as few as possible, and not to go outside them.

We have received from the hon. secretary (Mr. B. Sankey) a copy of the *Proceedings* of the First Congress, 1915, of which a report appeared in our issue of January 7th, 1916; the volume contains the papers read and the discussions which followed, and compares favourably with the records of other and older societies.

Australian Association of British Manufacturers.—This Association has offered its assistance and co-operation in connection with a scheme of the Imperial Government for a travelling exhibition of British manufactures, which is to visit Africa and all the principal parts of Australia. The Association had before it, at its annual meeting in December, the following resolution :—

No representative of British manufacturers who enters into any agency agreement, or in any way represents any manufacturer whose principal works are situated in any country decided by the Executive Council to be, or to have been, hostile or unfriendly, shall be entitled to membership of this Association, nor shall be allowed to continue membership.

The result of the ballot is to be considered at a general meeting of members. The Association decided to form a guarantee fund to fight any case that, in the opinion of the Council, is necessary for the benefit of members generally.

Lighting Restrictions in Germany.—It is considered that the lighting restrictions which have now been brought into operation in Germany by order of the Federal Council will have a far-reaching effect on the working and financial results of gas and electricity supply works, particularly in regard to the lighting consumption in large towns and public lighting also in the country. Hitherto, the war has exercised influence on these works in two directions. On the one hand, the war has caused a great limitation in building work, and has, consequently, curtailed the establishment of new connections, while, on the other, the scarcity of petroleum has brought about an influx of new customers for the electric light and gas, so that the initial decline in the case of these two illuminants was rapidly overtaken, and a further increase was recorded. As compared with this state of affairs, the working of the gas and electricity supply works was rendered more costly, owing to the advance in coal prices and the absence of English coal, which was formerly largely used in gas works, and a fresh increase in the cost of production will now take place as a result of the new advance in the sale prices for coal which was made on January 1st, 1917.

The order for exercising economy in lighting agencies will presumably be of detrimental influence on the working results chiefly of gas and electricity works, because these are largely in muncipal ownership. The number of public supply works rose from 1,978 in 1909 to 4,040 in 1913, and the aggregate value of the connections passed from 1,860,860 kw. to 3,725,769 kw. in the same years respectively. These figures represent an augmentation of almost 100 per cent. in four years, whilst the capacity of the works in machinery and accumulators advanced from 1,161,609 kw. to 2,095,666 kw. in the same period. As to the division of the supply between lighting and power customers, it appears that out of the total value of the connections in 1909, 40·7 per cent. devolved upon lighting and 59·3 per cent. on power connections; but in 1913 a further displacement took place to the disadvantage of the lighting connections, which receded to 35·8 per cent., whereas the power connections rose to 64·2 per cent. The number of places supplied with current advanced from 4,700 in 1909 to 17,500 in 1913, and it is assumed that an aggregate capital of £125,000,000 was invested in public electricity works at the end of 1913, exclusive of the value of the connections from the distributing mains to the consumers' premises.

It is impossible to form any definite opinion as to the extent of the influence which the lighting economy scheme, which also applies to supply to tramways, will have upon the electricity works. A geat deal will depend upon the limitations in private lighting, the course of coal prices (which are now much higher), and of the prices of other raw materials, and the sale price for electricity, which has already been raised at Frankfort-on-Main. On the other hand, a partial compensation for reduced lighting consumption is looked forward to in the direction of an increased delivery of energy for power purposes, especially in connection with the industries engaged on war work.

Inquiries.—We are asked for the names of makers of the McNicol boiler, "American Interstate Novelties," and "Titan" electric lamps.

Research in Glass and Optics.—A Standing Committee on glass and optical instruments has been established by the Government's Department of Scientific and Industrial Research. Sub-Committees have been appointed to deal with various special problems, including raw materials for glass and glass-making, general physical and chemical properties of glass and glassware for scientific and industrial purposes, X-ray glass apparatus, &c.

Engineering Labour.—The Executive Committee of the Amalgamated Society of Engineers suggests that the only way to bring about an amalgamation of the engineering and shipbuilding industries is by bringing about, first of all, a fusion of two or three societies. The amalgamation of the A.S.E., the Boilermakers, and the Ironfounders would bring into being a single union capable of effectively controlling the industry, and the adherence of the smaller societies would follow.—*The Times.*

War Loan.—Last week a successful War Loan rally took place among the employés of the British Thomson-Houston Co., Ltd., at Willesden Switchboard Works. Meetings were held during the week, at which great enthusiasm was shown, the response to appeals made being extremely gratifying; over 700 15s. 6d. War Loan certificates were applied for on Friday and Saturday alone.

Excess Profits Duty.—In response to an application by the Cape Electric Tramways, Ltd., the Board of Referees has ordered that the statutory percentage as respects the carrying-on of electric tramway business in Cape Colony in which the whole of the share capital is held by companies registered in the United Kingdom, the tramways not being carried on by municipalities, be increased to 7½ per cent. for a company or other body corporate, and to 8½ per cent. for any other trade or business.

The London Omnibus Owners' Federation applied for an increase, and has been given an increase to 8 per cent. in the case of a company or other body corporate, and to 9 per cent. for others.

Electric Light Switching Exams.—During the war Messrs. A. P. Lundberg & Sons have discontinued giving prizes; those wishing to investigate the subject can start working a paper without delay, a certificate being awarded if the paper merits it. Those interested should write to the firm at 477-489, Liverpool Road, London, N.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station and Tramway Officials.—The Newport (Mon.) Council has approved a recommendation to increase the salary of Mr. A. NICHOLS MOORE, tramways manager and borough electrical engineer, by £100 per annum, increasing the maximum from £400 to £500.

The Battersea B.C. is recommended to sanction the following increases in the salaries of officers in the electricity department:—Mr. H. F. G. Thompson, assistant electrical engineer, from £285 to £310 per annum; Mr. T. Bennett, station superintendent, from £205 to £225; Mr. E. S. Colley, shift engineer, from £160 to £170; Mr. C. E. F. Evans, shift engineer, from £160 to £170; Mr. H. V. Healy, shift engineer, from £160 to £170; Mr. W. T. Magrath, mains assistant, from £132 10s. to £150; Mr. W. Mears, meter superintendent, from £156 to £166; Mr. A. S. Knight, installation inspector, from £125 to £130; Mr. J. C. Adams, office clerk, from £107 10s. to £115; Mr. H. T. Strugnell, storekeeper, from £125 to £130; Mr. E. N. F. Grant, commercial assistant, from £104 and commission to £168 per annum and no commission.

The Wigan Electricity Committee has awarded a grant of £25 to Mr. BULL as an appreciation of his services during the four months that he has been acting as electrical engineer; a similar grant has been made to Mr. BECK.

The staff of the Lincoln municipal electricity works has presented a clock to Mr. J. W. HALKES, only son of Coun. T. C. Halkes, on the occasion of his marriage to Miss M. M. Elkington, also of Lincoln.

The Bradford Electricity Committee recommends advances in salary to officials in the department as follow:—Mr. Thos. Roles, city electrical engineer, £800 to £900; Mr. J. H. Shaw, deputy engineer, £350 to £450; Mr. James Fairburn, works superintendent, £300 to £350; Mr. C. E. Allsopp, commercial assistant, £250 to £300. The Tramways Committee recommends advances as follows:—Mr. J. W. Dawson, assistant electrical engineer, £295 to £325; Mr. T. Stirk, traffic superintendent, £270 to £300; Mr. T. B. Moseley, chief clerk, £200 with £20 bonus to £225 without bonus.

The Maidstone T.C. has decided to increase the salary of Mr. LAMBERT, manager of the tramways, from £275 to £300 a year, as from January 1st last.

The Reading T.C., on the recommendation of the Tramways Committee, has decided that Mr. J. MCLELLAN CALDER, chief assistant engineer of the undertaking, be refused leave of absence for military service.

General.—Congratulations to Lieutenant-Colonel ALFRED ERNEST LE ROSSIGNOL, London Electrical Engineers, upon his appointment as C.B. (Civil Division). Also to Mr. V. L. RAVEN, now Superintendent of Woolwich Arsenal, who was lent to the Government by the North-Eastern Railway, for which he was chief mechanical engineer, who receives the honour of knighthood; to Mr. WM. WEIR, a well-known Scottish engineer, and Scottish Director of Munitions, who receives a similar honour; and to Sir R. SOTHERN HOLLAND, H.M. Trade Commissioner in South Africa from 1908 to 1913, who becomes a baronet.

Trooper H. GIRDLESTONE, of the Queen's Own Yorkshire Dragoons, and of the B.T.H. Co.'s Sheffield staff, and son of Mr. J. O. Girdlestone, of the Westminster Engineering Co., Ltd., has returned from service in France to take up a commission in the R.N.V.R., for electrical duties with the Naval Air Service. Mr. Girdlestone joined the Yorkshire Dragoons in August, 1914, and has been in France for 19 months.

Mr. C. F. BUTLER, A.M.I.E.E., has joined the staff of the British Engine, Boiler & Electrical Insurance Co., Ltd., as assistant engineer in the electrical department at the company's head office at Manchester.

Roll of Honour.—Second-Lieutenant L. A. O'MEARA, East Lancashire Regiment, who was recently killed, aged 19, was the only surviving child of Major W. A. J. O'Meara, late R.E.

Private W. CROWE, Manchester Regiment, who was on the staff of the Bury (Lancs.) Corporation electricity works, has died of disease whilst on military service, aged 42 years.

Private C. V. Moore, Durham Light Infantry, who has fallen in action, enlisted 18 months ago, whilst with Messrs. Cox-Walker, of Darlington.

The Military Medal for distinguished conduct in the field has been awarded to Corporal A. J. POTTER, K.R.R., who was with Messrs. Willans & Robinson, of Rugby.

Sergeant CHARLES ELLIOTT ATKINS, who joined the Signal Section of the R.E. whilst with the British Thomson-Houston Co., Ltd., of Rugby, has been awarded the Military Medal for gallantry in action.

Private WILLIAM BOOTH, of the Grenadier Guards, who has died in a South of England hospital, aged nearly 19, whilst undergoing training, was, prior to joining up, with the Halifax electricity department.

Lieutenant CECIL HOPKINSON, R.E. (Signal Officer), youngest son of the late Dr. John Hopkinson, F.R.S., has died of wounds received in action, aged 25 years. He was wounded in the head on November 24th, 1915, and died at Cambridge on February 9th, 1917. The *Times* states that at the outbreak of the war he was at Sir Charles Parsons's works at Newcastle-on-Tyne. Lieutenant Hopkinson had been mentioned in one of Sir D. Haig's dispatches.

We regret to announce that Mr. W. E. EVANS, chief clerical assistant at the London showrooms of the Edison Swan Electric Co., Ltd., died last week, after only three weeks' service with the Royal Flying Corps.

Obituary.—THE DUKE OF NORFOLK.—We regret to record the death of the Duke of Norfolk, which occurred on Sunday last, from gastric influenza, at the age of 69 years. The late Duke was Postmaster-General from 1895 to 1900. Though His Grace was naturally occupied with innumerable and vast affairs, mechanical and electrical engineering matters formed for him a congenial hobby, in which he had long displayed a considerable and intelligent interest.

MR. CHAS. E. SPURRIER.—The death has occurred, as the result of a motor cycling accident, of Mr. Chas. E. Spurrier, the proprietor of the oldest established firm of contracting engineers in Wolverhampton. The Wolverhampton Electric Fittings & Installations Co. was established by him about 25 years' ago, and he was responsible at that time for some of the earliest installations of electric lighting in the town, the municipal supply not being then inaugurated. During the past few years he had taken an interest in the development of hydro-electric schemes in connection with the lighting and power requirements of farms and villages. He was a member of the Electrical Contractors' Association, and of the Committee of the Wolverhampton & District Engineering Society.

Will.—The late Sir GEORGE FRANKLIN left £108,167 gross and £98,625 net.

NEW COMPANIES REGISTERED.

New Switchgear Construction Co., Ltd. (145,964).—Private company. This company was registered on February 9th, with a capital of £10,000 in £10 shares, to carry on the business of electrical engineers, manufacturers of and dealers in switchgear, transformers, heating, and lighting apparatus, &c. The Board of Trade has authorised the company to acquire part of the undertaking of the Switchgear Construction Co., Ltd., the books and documents of which are liable to inspection under the Trading with the Enemy Act. The usual provisions to ensure the British character of the new company are inserted in the Memorandum of Association. The subscribers (each with one share) are:—J. Hall, The Haven, St. James Road, Sutton, Surrey, electrical engineer; C. E. Cleeves, Heddfan, Sketty, Glam., managing director of private company. Table "A" mainly applies. Solicitor: W. E. Singleton, 37, Essex Street, W.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Seear, Scott & Co., Ltd.—Particulars of £1,000 debentures created January 26th, 1917, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Tyne Electric Steel Foundries, Ltd.—Issue on January 25th, 1917, of £2,700 debentures, part of a series of which particulars have already been filed.

Sheerness and District Electric Power & Traction Co., Ltd.—A memorandum of satisfaction in full on January 1st, 1917, of debentures dated November 4th, 1913, securing £200, has been filed.

Banbury and District Electric Supply Co., Ltd.—A memorandum of satisfaction in full on December 30th, 1916, of debenture dated March 26th, 1913, securing £100, has been filed.

Woking Electric Supply Co., Ltd.—A memorandum of satisfaction to the extent of £3,000, between May 2nd, 1914, and February 2nd, 1915, of debenture stock issued under trust deed dated March 1st, 1906, securing an indefinite amount.

D. P. Battery Co., Ltd.—Particulars of £6,000 debentures created January 18th, 1917, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Oliver Arc Lamp, Ltd. (90,880).—Capital, £2,000 in £1 shares. Return dated December 6th, 1916. 1,407 shares taken up; £7 paid; £1,400 considered as paid. Mortgages and charges: £15,000.

CITY NOTES.

Metropolitan Railway Co.

At the annual meeting, Lord Aberconway said that they were sparing no pains to lay the foundation for increased business. Judging from the actual passenger traffic, there was a normal and steady increase in the sources from which they might expect to derive their passenger revenue in the future. They hoped also that the development of their goods traffic would correspond. The company's position in the matter of reserves was stronger than it had ever been before. What the position of railway companies generally might be after the war it was impossible to say. There might be legislation involving a continuance of Government control in some form, or there might be even more radical changes; but, whatever happened, it would be all to their advantage that their reserves were substantial and their financial position

generally a thoroughly sound one. If, when the present Government control and guarantee were terminated, they reverted to the position of independence that they occupied before the war, they, in common with other railway companies, would be faced with very largely increased expenditure, and unless they were permitted to take steps to enlarge their revenue by the raising of fares and rates it would not be an easy matter to make ends meet.

Edison Swan Electric Co., Ltd.

A meeting of the first debenture stock holders was held on Monday, at which the scheme of arrangement was approved. Mr. C. J. Ford, the chairman of the company, explained the scheme. He said that it provided for £100,000 of new money being brought into the business, through the medium of the issue of 100,000 preference shares; for the increase of the interest payable upon the first debenture stock from 4 to 5 per cent. per annum, together with the increase of the interest upon the second debenture stock from 5 to 5½ per cent. per annum; for the provision of an annual sinking fund for the redemption of both classes of debenture stock, and the ultimate merging of the second debenture stock with the first debenture stock into one class, bearing interest at 5 per cent. per annum; and for the relinquishment of the security which both classes of debenture stock held on the £2 per share uncalled upon the partly-paid "A" shares. Four years ago, when he first became connected with this company, it was apparent to him and to others interested that further working capital was urgently required if the company was to maintain a proper place amongst the greater electrical undertakings of this country, and a scheme was brought before the debenture-holders having with its object the provision of further working capital, but the majority of them did not see their way to sanction the directors' proposals. Since that time the company's trade had very largely increased, and the necessity for further capital had become very much accentuated, so much so that unless this could be provided the company's present position and prospects would be seriously prejudiced.

Adelaide Electric Supply Co., Ltd.

The gross profit for the year ended at August, 1916, was £136,541, as against £119,897 for the previous year, an increase of 17 per cent., as against 7 per cent. in the previous year. After paying debenture interest and charges, management and general expenses, and putting £3,000 to reserve for excess profits, the credit balance is £52,046. An interim dividend of 5 per cent. was paid in June last, and the following are now recommended:—A final dividend of 5 per cent., free of income-tax, on the ordinary shares, making 10 per cent. for the year; a bonus of 2 per cent., free of income-tax, a final dividend of 5 per cent., free of income-tax, on 19,784 ordinary shares (new issue), a bonus of 2 per cent., free of income-tax, on amounts paid up, leaving £3,160 to be carried forward.

Yorkshire Electric Power Company.

The report shows that for the year ended December, 1916, the net profit, after payment of mortgage and other interest, was £29,112, as against £21,209 for 1915, and £20,535 for 1914. Including £2,478 brought forward, the total available is £31,590, out of which 6 per cent. on the preference shares absorbs £9,408, £12,000 is transferred to general reserve fund, 3 per cent. is to be paid on the ordinary shares (£6,316), and £3,866 is to be carried forward. Seventy-eight members of the staff are with the Forces; five have laid down their lives. The staff have rendered loyal service to the company during the year, under very difficult conditions. Costs of labour and supplies have been heavy, but the company has returned to the steady progress interrupted by the war. The advantage of the supply is being realised, and to meet the demands in every part of the area (especially in the southern and eastern divisions, where collieries and steel works are being rapidly developed), additional generating plant has been ordered. Owing to urgent requirements, £60,000 is being advanced by the Government towards the cost of the extension. This is secured by second mortgage. Of the £71,640 in cumulative preference shares authorised in September last, £34,490 has been taken up, and the balance is being allotted as applications are received. The whole of the £47,000 debenture stock of the Waste Heat Co. has now been taken up. Annual meeting: February 20th, at Leeds.

The Compagnie Madrilene d'Electricité.

The misfortunes of this company, which at one time absorbed the English Supply Co. at Madrid, and in which French capital is also interested, have been set forth in the Spanish capital. The *Gaceta* of January 3rd, for instance, contains a notice that, in accordance with the judgment of insolvency of December 13th, 1916, the company or its legal representative was required to produce the company's general balance sheet within a week. The *Economista* states that the company's appeal was rejected, and bankruptcy was therefore inevitable. The assets, which were represented by shares and debentures, amounted to a nominal value of 20,000,000 pesetas (£800,000), less approximately 2,500,000 pesetas (£100,000) of securities removed for the company's needs before the suspension of payment. The committee of debenture-holders appointed in November, 1911, is said to have made an excellent campaign, and obtained happy results from a judicial point of view. Negotiations were continued with the French debenture-holders, who were represented by the Association des Valeurs Mobilières, in order to harmonise the objects in view. The matter of the Supply Co. (the English company absorbed by the Madrilene Co.) has also been investigated, a company which is declared to be "a legacy burdened with cost of administration in England and fiscal charges in Spain, in notable disproportion to the amount of the debt, which suggests the seeking, if possible, of a formula which would cause the English company to disappear promptly." The committee has not neglected an examination of the possible solutions which would permit, within the limits of the guarantee which the declaration of bankruptcy has given to the debenture-holders, of the finding of an arrangement with the company, but so far no practical results have been achieved. On the other hand, the committee has been able to appreciate the prosperous course of the Union Electrique Madrilene, which is all for the benefit of the Compagnie Madrilene and is the sole asset of the debenture-holders.

Swiss Electrical Companies.

The *Watt, A.G. fur Elektrische Unternehmungen, of Glarus*, which is closely associated with the Zurich Bank for Electrical Undertakings, and is also an investment company, reports that any further extension of activity in 1915-16 was stopped through the conditions of war, so that the investments were again limited to those prevailing in the previous year. The net profits for 1915-16 amount to £9,000, as contrasted with £18,000, and the dividend on the ordinary capital is 3 per cent., as against 5 per cent. in 1914-15.

The Columbus, A.G. fur Elektrische Unternehmungen, of Glarus, which belongs to the Brown-Boveri group, and was formed three years ago to acquire the majority of the shares in the Compania Italo-Argentina de Elektricidad, of Buenos Aires, reports net profits of £51,000 for 1915-16, as compared with £46,000 in the previous 12 months, on an ordinary share capital of £800,000. It is proposed to pay 5 per cent., being the same rate as in 1914-15. The directors state that the machinery export difficulties in Europe in the past year continued to hamper the development of the Buenos Aires Co., whose works, however, were to be enlarged, the present output representing approximately 27,000 KW.

The War Loan.—Since our last reference to applications from electrical and allied firms for War Loan, the following have been announced. The figures in parentheses represent new loan:—

	£	£
Anglo-Argentine Tramways Co.	(240,000)	650,000
Victoria Falls & Transvaal Power Co.	(400,000)	500,000
Brisbane Tramways Co.		108,400
Babcock & Wilcox	(140,000)	500,000
Phosphor Bronze Co.	(20,000)	20,000
British Mannesmann Tube Co.	(50,000)	50,000
Marconi Wireless Telegraph Co.	(100,000)	200,000
Marconi International Marine Communications Co.	(50,000)	50,000
British Electrical Federation, Ltd.	(220,000)	355,000
Ditto, Staff Scheme	(10,000)	
Boving & Co. and Electro Metals, Ltd., and Managing Directors	(12,000)	
Auckland Electric Tramways Co.		50,000
Para Electric Railway & Lighting Co.	(25,000)	
Stewarts & Lloyds	(400,000)	500,000
India-rubber, Gutta-percha & Telegraph Works Co., Ltd.	(30,000)	
Lodge Sparking Plug Co.	(20,000)	25,000
James Scott, Ltd.	(1,000)	
Vulcan Boiler & General Insurance Co.	(25,000)	50,000
O. C. Hawkes and O. C. Hawkes, Ltd.	(20,000)	
Falk, Stadelmann & Co.	(26,100)	54,000
Sterling Telephone & Electric Co.	(25,000)	25,000
Liverpool Overhead Railway		10,000
Mersey Power Co.	(5,000)	5,000
Brown, Boveri & Co.		4,000
General Electric Co. and its Allied Companies' Staff and Employés	(26,500)	26,500

National Gas Engine Co., Ltd.—The net profit for 1916, after providing amply for depreciation of buildings, plant, tools, &c., and allowing for management, salaries, and income-tax, was £95,915. After paying the preference dividend, and 7½ per cent., less income-tax, on the ordinary shares, plus a bonus of 9d. per share, £46,334 remains to be carried forward.

Crossley Bros., Ltd.—Dividend on the ordinary shares, 7 per cent. per annum for the past half-year, making 6 per cent. for the year.

Telegraph Construction & Maintenance Co., Ltd.—The directors propose to distribute, in addition to the interim dividend of 5 per cent. paid in July last, a further dividend of 10 per cent., together with a bonus of 12s. per share.

Electrical & Industrial Investment Co., Ltd.—For 1916 there was a profit, after payment of all management expenses and interest on debenture stocks, of £13,489, plus £10,877 brought forward, making £24,367. The directors recommend a dividend of 5 per cent. on the preferred ordinary shares, carrying forward £13,367. They have continued to act on the principle of adding to reserve the profits made on sales of investments and of charging losses on realisation against the reserve.

Tottenham District Light, Heat & Power Co.—Dividends for the past half-year at the following rates:—5 per cent. on the preference stock, 5 per cent. on the "A" stock, and 3½ per cent. on the "B" stock, all less income-tax.

Metropolitan District Railway Co.—Dividends: On the four per cent. guaranteed stock for the last half-year, 2 per cent., making 4 per cent. for the year; on the four and a-half per cent. first preference, 2¼ per cent., making 4½ per cent.; on the five per cent. second preference stock, 1½ per cent., making 3 per cent., carrying forward £20,688.

Underground Electric Railways Co.—The full interest to 31st December on the six per cent. first cumulative income debenture stock is to be paid and 2 per cent., free of tax, on the six per cent. income bonds of 1948, making 5 per cent., free of tax, for the year; carry forward, £30,000. The revenue shows a reduction of £27,000, while the increased income-tax and loss in foreign exchange exceed £56,000.

Blackpool & Fleetwood Tramroad Co.—The net earnings for 1916 after the payment of debenture interest and fixed charges were £18,256, making, with the amount brought forward, £22,505. The directors recommend the payment of final dividend of 4½ per cent. (making 6½ per cent. for the year), placing to general reserve account £1,000, to depreciation re serve account £5,000, writing down value of investments in railway stock £3,005, and carrying forward to next account, subject to excess profits duty, £3,750.—*Financial Times.*

Davis & Timmins, Ltd.—After allowing for depreciation and other charges, and including £39,092 brought forward, the net profit is £103,242. £5,000 is put to general reserve, £5,784 to income-tax account, and £1,672 to depreciation on investments. The dividend on the ordinary shares is 8 per cent. for the year, free of income-tax, and a bonus of 17 per cent. is to be paid, free of income-tax, leaving to be carried forward, subject to special taxation, £75,436.

Liverpool Overhead Railway Co.—Final dividend for the last half of 1916 at the rate of 5 per cent. per annum (less income-tax) on the preference shares and 4 per cent. per annum (less income-tax) on the ordinary shares, making for the year 5 per cent. on the preference and 3¼ on the ordinary shares.

London Electric Railway Co.—Dividend, 2 per cent. for the past half-year on the preference, making 4 per cent. for the year; ¾ per cent. on the ordinary, making 1½ per cent. for the year, carrying forward £24,474.

Central London Railway Co.—Dividend on the undivided ordinary stock for the past half-year, 1¾ per cent., making 3½ per cent. for the year; 4 per cent. is paid for the year on the preferred ordinary, and 3 per cent. on the deferred ordinary, carrying forward £12,079.

City & South London Railway Co.—Dividend on the consolidated ordinary stock for the past half-year, ¾ per cent., making 1½ per cent. for the year, carrying forward £17,245.

National Electric Supply Co., Ltd.—The gross profit for 1916 was £12,180. The directors recommend a dividend of 3s. 6d. per ordinary share, making 6s. per share (against 7s. for 1916). £4,000 is reserve for depreciation, and £2,038 interest on bonus.

Smithfield Markets Electric Supply Co., Ltd.—The dividend for 1916 is 1 per cent. (as against 2 per cent. for 1915), carrying forward £1,000.

Central Electric Supply Co.—In the accounts for 1916, after payment of interest on debenture stock, £19,557 is placed to depreciation fund, and £1,257 to writing off (one-half) discount on issue of debenture stock. £6 is carried forward.

Underfeed Stoker Co., Ltd.—Dividend at the rate of 5 per cent., less tax, for 1916.

STOCKS AND SHARES.

Tuesday Evening.

The interesting point of speculation is how soon Stock Exchange markets will recover from the effect of the enormous amount of money which has been put up in payment for War Loan stock. For nearly a month the War Loan has appropriately assumed the first place in everybody's consideration; and, as we have said before, one of the surprising parts about the colossal issue is the fact that existing securities should have suffered so comparatively little. Prices have gone down, of course; they were bound to do so. Had the fall been much more extensive in its area, however, no one would have been astonished, particularly as so many people sold good securities in order to apply for the new loan.

There is an idea current at the time of writing that the subscription lists may be kept open a little longer than the previously advertised time; but most people would be glad to find this report turn out to be incorrect, because if the lists remained open it would certainly lend the impression that the loan has not been the triumphant success which we feel sure the final figures will show it to have scored.

Markets, of course, are listless and quiet. It is hardly to be expected that they will take a turn for the better until two or three weeks have elapsed from the closing of the War Loan lists, because, quickly as money accumulates, it will probably take a month for conditions to settle down into the normal again. The chief point of interest this week has been the extraordinary demand for War Loan sweepstake tickets, which have gone off like the proverbial hot cakes, only quicker. The sweep comprises 950, 1,900, or 2,700 tickets of £1 each, with nine prizes per £1,000 War Loan attached; and the organisers find that they can dispose of a batch in less than an hour, outsiders as well as members of the House being amazingly keen on this form of investment.

Apart from the sweepstakes, Home Railway dividends claim a good deal of attention. In the Underground group, the reduction of the interest payment on the 6 per cent. income bonds of the Underground Electric Railways of London was a sharp disappointment, and led to a drop of 6½ points in the price. The previous rise had brought out a good deal of stock; and those who bought are now talking about the "knowing old corpse" who figures as the deceased account said to have been responsible for the amount of stock available.

The company's explanation of the reason for the decline—namely, the advance in income-tax and working charges—is comprehensible enough, but certainly there were very few who looked for a lowering of the dividend this half-year. The £10 shares have come down from 2⅛ to 1⅝, and the vague hopes entertained of a possible dividend on these are incontinently shattered for the time being. The shilling shares are quoted about 5s.

Other members of the group have not done at all badly. On Central London deferred the dividend is at the rate of 3 per cent., as against 2 per cent. this time last year. The District Co. is paying 3 per cent. on its second preference stock, the London Electric 1½ per cent. on its £10 shares, and the Central London 3½ per cent. on the ordinary stock, all these being the same as the distributions of a year ago. The London General Omnibus Co. declares a dividend making 8 per cent. for the year, as against 12 per cent. for 1915.

Amongst the steam-electric lines, the Brighton Co. announces 4 per cent. on its deferred stock, as in 1915, and this is something of a disappointment, because the optimists had looked for 4½ per cent.; while the maintenance of the London & South-Western dividend, upon which we commented last week, also failed to meet the hopes of something better as compared with last year. The result is that most railway stocks are lower on the week.

Central London deferred non-assented stands out as a conspicuous exception with a rise of 5 points at 32½, but other stocks in this section are dull. London Electric ordinary shares fell to 2⅜. Districts dropped to 16, and steam-electric issues are somewhat heavy. London United Tramways 4 per cent. debentures declined to 41. London General Omnibus debenture stocks are a little easier.

The electric supply section had another pleasant disappointment in the shape of the Westminster dividend, making 7 per cent. for the year, the same as that declared in the previous twelvemonth. This was a decided improvement upon anticipation. No change occurred in the price of the shares, but the market generally is harder. The turning up of the lights in certain parts of London cast a modified brightness upon the market, although the difficulties experienced by householders in the way of obtaining coal supplies was a sharp reminder that illumination companies have probably suffered similarly.

The telegraph market is inclined to be dull. There is not much doing in the stocks, but the usual buyers have been putting their money into the War Loan, so that would-be sellers who wanted to realise their stock for the same purpose found that they had to accept lower prices. Consequently, the Eastern group is dullish, Indo-Europeans are 50s. down, Great Northerns £1, and in one or two cases it has been none too easy to find buyers, even for the best-class shares. This is the sort of thing which, of course, will be rectified before very long, because as soon as the call for patriotic investment is silent, the bargain-hunter will be out looking for cheap stock; indeed, his presence has been observed in several markets this week.

Amongst foreign issues, the American-Canadian power companies' shares are inclined to droop, and Kaministiquia stands out with a fall of 5 points at 125½. The shock administered to Wall Street by the possibility that the United States might enter the active theatre of hostilities is practically over, and many prices have regained the falls which they experienced upon Germany's defiance of America in connection with the submarine warfare. "America won't fight," say a good many men in the City.

Brazilian stocks and shares of all classes, including Brazilian Tractions, have been disposed to dulness; and the Argentine group is also somewhat heavy. British Columbia electric issues have sympathised with the general tendency; business in these has been quiet, like that in other markets of the Stock Exchange.

The quietude of markets and the issue of the War Loan have been jointly responsible for the rumour that the Stock Exchange Committee are discussing the suggestion for closing the House at one o'clock, instead of leaving it open until three o'clock, as to which there may be an official pronouncement in the course of the next few days.

The industrial market is reasonably steady. There are scarcely any changes in the manufacturing shares of electrical and cable companies. The iron and steel division is still dull; and rubber shares, notwithstanding a further rise in the price of the commodity to 3s. 3½d. per lb., are inanimate. There is nothing fresh to add in regard to the market

for copper shares, while that for other base metal descriptions is slightly weaker. Victoria Falls preference eased off to 19s. 9d., the ordinary shares giving way in sympathy to 12s. 6d. The reason given for the shrinkage is the same as that which has been uniformly put forward since the War Loan lists were opened.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1914.	Dividend 1915.	Price Feb. 13, 1917.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	10	10	6⅝	—	£7 11 0
Charing Cross Ordinary	5	5	3⅜	—	7 8 2
do. do. 4½ Pref.	4½	4½	3 7/16	+ 1/16	6 15 10
Chelsea	5	4	3	—	6 13 4
City of London	9	8	11	—	7 5 5
do. do. 6 per cent. Pref.	6	6	9¾	—	6 3 1
County of London	7	7	10	—	7 0 0
do. 6 per cent. Pref.	6	6	9½	— ½	6 6 4
Kensington Ordinary	9	7	6⅝	—	6 10 3
London Electric	4	3	1½	—	7 2 10
do. do. 6 per cent. Pref.	6	6	4½	—	7 1 2
Metropolitan	3½	3	2½	—	6 13 4
do. 4½ per cent. Pref.	4½	4½	3¾	—	7 4 0
St. James' and Pall Mall	10	8	6	—	6 13 4
South London	5	5	2⅞	—	8 19 0
South Metropolitan Pref.	7	7	1 5/8	—	8 7 3
Westminster Ordinary	9	7	5⅜	—	6 4 5
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	94½	—	6 7 2
do. Def.	30/-	33/6	22	—	6 16 4
Chile Telephone	8	8	7	—	5 14 3
Cuba Sub. Ord.	5	5	8½	—	8 8 6
Eastern Extension	7	8	193	— ⅛	*5 16 4
Eastern Tel. Ord.	7	8	185	—2	*5 18 6
Globe Tel. and T. Ord.	6	7	11⅝	— ¼	*5 19 2
do. Pref.	6	6	9½	— ⅛	6 3 1
Great Northern Tel.	22	22	84	—2	6 9 5
Indo-European	13	13	46¼	—2½	6 19 9
Marconi	10	10	2⅝	—	8 9 6
New York Tel. 4½	4½	4½	101	—	4 9 0
Oriental Telephone Ord.	10	10	2	— ½	5 0 0
United R. Plate Tel.	8	8	6⅜	—	*6 5 6
West India and Pan.	1	6d.	1	—	2 4 0
Western Telegraph	7	8	13⅜	— ⅛	*5 16 4
Home Rails.					
Central London, Ord. Assented	4	4	62½	—	6 8 0
Metropolitan	1½	1	25xd	— ½	4 7 0
do. District	Nil	Nil	16	— ¼	Nil
Underground Electric Ordinary	Nil	Nil	1⅜	— ⅜	Nil
do. do. "A"	Nil	Nil	5/-	—1/-	Nil
do. do. Income	6	6	84	+6½	*5 19 1
Foreign Trams, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	4 13/16	—	6 1
Anglo-Arg. Trams, First Pref.	5½	5½	3	—	9 4
do. 2nd Pref.	5½	5½	2⅜	—	—
do. 5 Deb.	5	5	64½	—	7 15 0
Brazil Tractions	4	4	47½	—1½	8 10 2
Bombay Electric Pref.	6	6	10	—	6 0 0
British Columbia Elec. Rly. Pfce.	5	5	61	—	8 4 0
do. do. Preferred	—	Nil	43	—	Nil
do. do. Deferred	—	Nil	37½	—1	Nil
do. do. Deb.	4½	4½	64	—	6 12 10
Mexico Trams 5 per cent. Bonds	—	Nil	25	—	Nil
do. 6 per cent. Bonds	—	Nil	22½	—	Nil
Mexican Light Common	Nil	Nil	7½	—	Nil
do. Pref.	Nil	Nil	14½	—	Nil
do. 1st Bonds	Nil	Nil	27½	—	—
Manufacturing Companies.					
Babcock & Wilcox	14	15	29⅝	— 1/16	5 14 3
British Aluminium Ord.	5	7	27/-	—	5 13 6
British Insulated Ord.	15	17½	11½	—	7 7 4
British Westinghouse Pref.	7½	7½	2½	—	6 13 4
Callenders	15	20	12½	— ¼	8 4 0
do. 5 Pref.	5	5	4	—	6 5 0
Castner-Kellner	20	22	3 3/16	+ 1/16	6 19 3
Edison & Swan, £3 paid	Nil	—	¼	—	Nil
do. do. fully paid	Nil	—	1⅜	—	Nil
do. do. 4 per cent. Deb.	4	4	61½	—	6 10 1
Electric Construction	6	7½	1	—	7 10 0
Gen. Elec. Pref.	6	6	9½	—	6 6 4
do. Ord.	10	10	18½	—	7 5 6
Henley	20	25	15½	— ½	8 1 3
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	12½	—	*8 3 4
Telegraph Con.	20	20	38	—	*6 5 0

* Dividends paid free of income-tax.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Month ended (4 wks.)	Receipts for the month. £		No. of weeks.	Total to date. £		Route miles open.	Inc.
Bristol (Trams)	Jan. 26	18,372	+ 329	..	16,975	+ 1,629	30·5	..
Cork	,, 25	1,593	— 198	4	1,593	— 198	9·89	..
Dublin	,, 26	22,588	+ 105	4	22,588	+ 105	54·25	..
Hastings	,, 28	3,712	+ 657	4	3,712	+ 657	19·3	..
Lancashire United	,, 31	6,750	+ 312	5	7,742	+ 324	42	..
Llandudno-Col. Bay	,, 26	740	— 18	8½	1,562	— 12	6·5	..
Anglo-Argentine	,, 28	19,849	+2,878	4	19,849	+ 2,878	..	..
Auckland	,, 12	23,977	+1,109	28	160,674	+ 1,966	36·29	..
Calcutta	,, 27	18,839	+1,126	4	18,839	+ 1,126	..	..
Kalgoorlie, W.A.	Nov.	2,555	..	..	28,538	..	20.5	..
Madras	Jan. 31	4,787	+ 360	4	4,787	+ 360	..	..
Montevideo	Jan.	33,311	— 911	39	93,109	— 855	..	..
Dublin-Lucan Rly.	Jan. 26	432	— 26	4	432	— 26	7	..

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, February 14th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/6	..
a Ammoniac Sal	per ton	£75	..
a Ammonia, Muriate (large crystal)	,,	£54	..
a Bisulphide of Carbon	,,	£23	..
a Borax	,,	£34	..
a Copper Sulphate	,,	£66	..
a Potash, Chlorate	per lb.	2/6	..
a ,, Perchlorate	,,	2/-	..
a Shellac	per cwt.	156/-	12/- inc.
a Sulphate of Magnesia	per ton	£16	..
a Sulphur, Sublimed Flowers	,,	£25	£6 inc.
a ,, Lump	,,	£19	£3 inc.
a Soda, Chlorate	per lb.	1/-	..
a ,, Crystals	per ton	120/-	..
a Sodium Bichromate, casks	per lb.	..	..
METALS, &c.			
c Brass (rolled metal 2" to 12" basis)	per lb.	..	..
c ,, Tubes (solid drawn)	,,	..	..
c ,, Wire, basis	,,	..	..
c Copper Tubes (solid drawn)	,,	1/8½ to 1/8¾	½d. inc.
g ,, Bars (best selected)	per ton	£170	£4 inc.
g ,, Sheet	,,	£170	£4 inc.
g ,, Rod	,,	£170	£4 inc.
g ,, (Electrolytic) Bars	,,	£147	£5 inc.
d ,, Sheets	,,	£172	£7 inc.
d ,, Wire Rods	,,	£155	£4 inc.
d ,, H.C. Wire	per lb.	1/6⅞	½d. inc.
f Ebonite Rod	,,	3/-	..
f ,, Sheet	,,	2/6	..
n German Silver Wire	,,	2/3	..
h Gutta-percha, fine	,,	6/10	..
h India-rubber, Para fine	,,	3/4½	2d. inc.
i Iron Pig (Cleveland warrants)	per ton	Nom.	..
l ,, Wire, galv. No. 8, P.O. qual.	,,	£38	..
g Lead, English Pig	,,	£32 5	..
g Mercury	per bot.	£19 15	..
e Mica (in original cases) small	per lb.	6d. to 8/-	..
e ,, ,, ,, medium	,,	3/6 to 6/-	..
e ,, ,, ,, large	,,	7/3 to 14/- & up.	..
d Silicium Bronze Wire	per lb.	1/10	..
r Steel, Magnet, in bars	per ton	..	..
g Tin, Block (English)	,,	..	..
n ,, Wire, Nos. 1 to 16	per lb.	3/-	1d. inc.

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons
r W. F. Dennis & Co.

Henley's War Relief Fund.—In aid of this Fund a successful concert was held on Friday last at the Cripplegate Institute, where members of the staff, and other volunteers, delighted a large and appreciative audience. The large hall was packed. In addition to a number of turns by the staff, the following friends gave their services:—Mr. Bernard Flanders, A.R.A.M., who acted as accompanist; Miss Jessie Fisher; Mr. Wilfred Alderton, the Royal Campanologist; and Mr. Grant Molene and his company of the Warwick Repertory Club. In the unavoidable absence of the managing director of the company (Mr. George Sutton), Mr. W. J. Potter took the chair, and in the course of the proceedings referred to the good work done by the Fund, the contributions to which, since the inauguration, had amounted to over £2,300. The parcels of little luxuries sent once a month to the Henley men at the Front, or prisoners in Germany, have almost, without exception, reached the men, and have been much appreciated. At the start of the war the Fund was more than sufficient to cover expenses, and various contributions were made to the Red Cross Fund and other war charities, but the number of Henley employés in khaki had now increased to a total of nearly 800, and although the Fund had, so far, been able to keep pace with the demand, the gradual increase had depleted the Fund, so that some assistance was now necessary. He announced that the proceeds of the concert would clear £25, and that other contributions brought the proceeds up to £65. Attention was also drawn to the facilities offered by the company to its employés who wished to contribute to the War Loan, *i.e.*, that the company would advance money to any of its employés, free of interest for two years, to enable them to do so.

The Price of Gas.—Addressing the half-yearly meeting of the Gas Light and Coke Co., Mr. John Miles (the Governor) said that it would be necessary in the near future to raise the price of gas. It would be impossible for the company to continue to supply gas at an increased price of only 20 per cent. when the prices of raw materials had increased so far in advance of that figure. Since the beginning of the war, coal had advanced in price 50 per cent., coal freights 400 per cent., and oil, including freights, 300 per cent. With a deficit of £129,000 in a half-year, and with the cost of oil and other items still rising, it was quite impossible for gas to remain at 3s.

IMPROVED METHODS OF POWER MEASUREMENT.

[Communicated.]

The following account of some new instruments intended to assist the supply authority in justly assessing the charges to be made to different classes of consumers will be of interest.

It appears obvious that a consumer who regularly takes the same power during the same hours each day should not be charged at the same rate as the consumer whose load is intermittent. In the first case the installation, particularly the cable, can be carried out with the minimum of expense, and operated at the maximum efficiency, whilst in the second case, the installation throughout must be capable of dealing with peak-load periods, which may easily be four or five times the average load, necessitating much larger cables, meters, &c., even though the average load over a month may be the same in both cases.

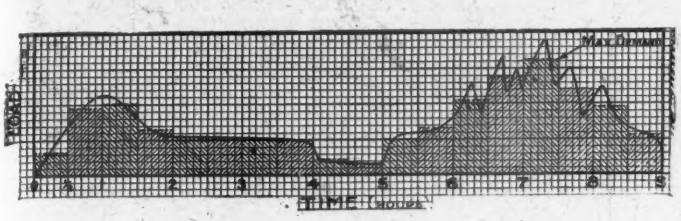

Fig. 1.—Load Curve.

Another important consideration must be borne in mind, namely, the hours during which the consumer takes his power, the power companies being able to supply a day or night load much cheaper than an evening load during the peaked lighting periods.

It is clear, therefore, that to charge by the unit on the total monthly units as measured on an integrating wattmeter is manifestly unfair to many consumers, and the "peaked demand" consumer should be penalised accordingly. For this purpose, a knowledge of the maximum demand is essential, and several ingenious devices have been designed to record this. These, however, are only partially successful, as they do not indicate at what period the maximum demand occurred, and if a fair basis of charging is to be devedoped this consideration is of great importance.

There are certain consumers whose "peak" or "maximum demand" is bound to occur at the same time each day, as, for instance, in the case of a spinning mill, and that time can be assumed with reasonable accuracy, a comparatively simple mechanism indicating this "maximum demand" with quite good results. But in the cases of consumers who are likely to demand heavy "peaks" at any period, the knowledge of the time at which this "peak" occurs is essential.

Two types of meters have, therefore, been developed by the British Westinghouse Co.:—

1. The "Maximum Demand Meter," indicating the maximum demand only.

2. The "Printometer," which records a printed record of the loads and the time at which they occurred.

To make the scheme possible, the "peak" period should have a moderate time limit, as a very short "peak," lasting one or two minutes, would not affect the supply to any great extent, and, if an isolated instance, should not be considered. When several such "peaks" occur in a short time, or an increasing demand occurs, these "peaks" must be registered.

The "maximum demand," therefore, should be the average rate at which power is consumed over a predetermined time. The time interval is determined from the conditions of the installation, and is usually either one half-hour or one hour, although 15 minutes is often utilised. Fig. 1 shows a rather improbable load curve divided into half-hourly periods. The shaded area under the dotted line indicates the total units integrated by the meter and recorded on the dial each half-hour, and the height of the ordinate to the dotted line gives the average rate at which the electrical energy passed through the meter during that half-hour, and which should be indicated by the "maximum-demand" pointer.

Both these features, namely, the total units passing and the maximum average rate at which the power was supplied—in other words, the "maximum demand"—are obtained with the British Westinghouse "Maximum Demand" Meter.

Figs. 2 and 3 show a polyphase watthour meter, on which the recording dial has in addition a large pointer which indicates the "maximum demand" during the period decided upon. Besides driving the ordinary recording mechanism, the rotating meter movement also drives a train of wheels, which in turn drives the maximum-demand pointer. This train of wheels is controlled by a suitable hair-spring, and when operating, drives against this spring, gradually winding it up. After the predetermined time has elapsed, the train of wheels is disengaged from the main recording mechanism, and the spring resets the wheels to the zero position.

The maximum-demand pointer is driven in one direction only by means of a small dog on the train of wheels, and when the mechanism resets itself to zero, the maximum-demand pointer remains stationary, being held in position by means of a small friction clutch.

The disengagement of the train of wheels is controlled by means of a time switch. This switch makes contact every half-hour or other period selected, and excites a small electromagnet, the armature of which is carried on the framework of the maximum-demand wheel train, this framework being suitably pivoted.

As soon as the armature is pulled up all the wheels return to zero practically instantaneously, although a period of about three seconds is allowed.

Assuming the meter is in operation, after the predetermined time interval has elapsed the maximum-demand pointer will indicate a certain reading.

During the following time interval, should the rate of consumption of current be greater than it was during the previous time interval, the maximum-demand pointer will be carried further round its scale, and when the mechanism resets itself a higher reading—the "maximum-demand"—will be indicated. On the other hand, should the rate of consumption of current be less than that during the previous time interval, the mechanism will not be carried round sufficiently to re-engage with the maximum-demand pointer, and the original indication of the earlier period remains.

The Printometer.—This instrument has all the features of the "Maximum-Demand" meter, with an important addition: that all the "peaks" are recorded together with the time at which they occur. In other words, a complete load curve is immediately obtainable. Figs. 4, 5, and 6 give various views of the instrument.

The principle is rather different from the indicating maximum-demand meter, there being no periodical resetting. The total units are recorded on an ordinary dial, the mechanism of this dial being also engaged with another recording mechanism.

The second mechanism—the "printer"—has three cyclometer dials with specially raised figures, with a carbon paper interposed between them and the paper recording chart. Under the paper are three plungers, operated by an electromagnet, which in turn is controlled by a time switch. Every

Fig. 2.—British Westinghouse Type "N."

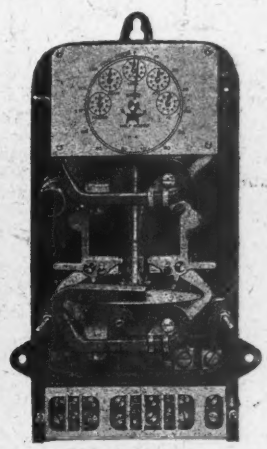

Fig. 3.—Maximum Demand Meter.

Fig. 4. "Printometer."

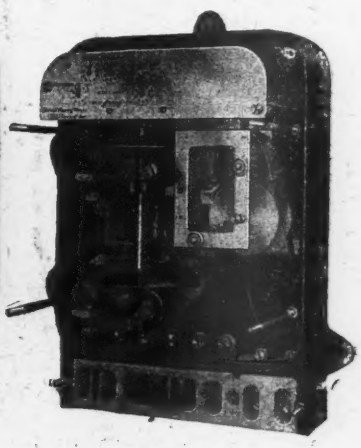

Fig. 5. Type "N" Meter.

half-hour, or whatever the predetermined time is, the plungers strike the chart and carbon paper against the figures on the printing dials, thus giving a printed record of load and time of occurrence. The chart is driven forward by

FIG. 6.—"PRINTOMETER" METER, SHOWING CHART REMOVED.

means of the time switch at the instant the "printer" mechanism operates, and lasts from 10 to 20 days, dependent on the time interval. A simple spool device permits of easy and quick renewal of the chart.

The "printer" mechanism does not reset to zero each period, and the total units up to time are recorded, both the ordinary and "printer" dials registering the same units. By subtracting the previous reading the "peaks" can be obtained, and if required a load curve may be plotted.

Below is given a table in the first column of which are the figures as recorded by the "Printometer." The second column,

Recorded total units up to time.	Load per half-hour in KW.-hours.	Maximum demand. KW.
300	—	—
310	10	20
325	15	30
352	27	54
384	32	64
405	21	42
415	10	20
423	8	16
450	27	54
504	54	108
525	21	42

obtained by subtracting the previous readings, gives the actual load in KW.-hours passing through the meter every half-hour. The third column gives the "maximum demands" which, in the case of half-hour time intervals, are double the

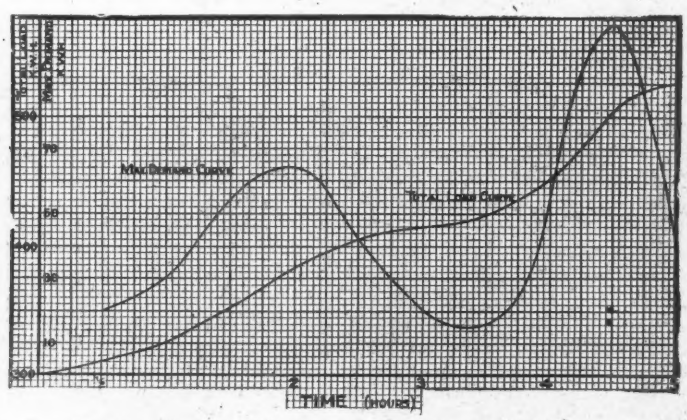

FIG. 7.—CURVES DEDUCED FROM "PRINTOMETER" RECORDS.

second column. Fig. 7 shows these results plotted. The total units up to any period, the actual load curve, and the "maximum demand" are easily obtained at any time.

There is undoubtedly a wide field for this instrument, which overcomes several difficulties experienced by supply companies.

Any standard time switch can be used with this instrument, but it is a matter of conjecture whether the hand or electrically-wound type is best; the latter loses most of its advantages when weekly or fortnightly visits have to be made to the meter.

(To be concluded.)

BOILER-HOUSE OPERATION AND MAINTENANCE.

(Continued from page 149.)

At all the stations except Vereeniging the ashes are dumped over the back of the grate into open hoppers below, from which they are discharged into coco-pans pushed by natives through the ash basement.

At Brakpan the average percentage of ash in the coal as fired is about 27 per cent., at Vereeniging about 18.5 per cent., and at Rosherville and Simmerpan about 17 per cent.

The average maintenance cost of ash haulage is .50d. per ton of coal burnt. This includes the maintenance of tracks, repairs and replacement of coco-pans, haulage ropes, and repairs to reduction gears and motors.

The above system was also installed at Vereeniging, but when burning anything over 1,000 tons of coal per day it was almost a physical impossibility for the natives to keep the basement clear of ashes. To overcome this a Zimmer vibrating convéyor has been installed; so far this has been a success. A conveyor is erected under each line of five boilers, discharging on to a cross conveyor, which discharges the ashes into a bin, from which they are fed into coco-pans and taken up to the dump by a rope haulage. It is found essential to saturate the ashes with water as they fall from the hopper on to the conveyor troughs; unless this is done the troughs become overheated and badly buckled.

The provision for dealing with ashes is often an afterthought in station design, but the efficient handling is a matter of the utmost importance at a power station running at a high load factor and burning any considerable tonnage of coal, and especially is this the case when it contains a high percentage of ash.

All the boilers, 102 in number, are of the Babcock and Wilcox marine type; the first eight boilers at Brakpan and the first 16 installed at Simmerpan have Green's economisers (steel cased) above the boiler; all other boilers have Babcock & Wilcox economisers integral with the boiler.

Draught in all cases is provided on the Prat ejector system. The Prat system is very convenient, and the maintenance costs are low, but the system is not as efficient as the ordinary plain induced draught.

In the case of one of the large fans working on two large boilers at Simmerpan (with 4-in. mixed coal fires, grate area 252 sq. ft. per boiler; 11.5 per cent. CO_2), the H.P. taken varied from 85 to 110, the corresponding draught at chimney uptake from economiser for each boiler varying from .7-.65 to 1.6-1.5 in. Figures are given for an official test of a Babcock & Wilcox marine boiler unit; the coal analysis showed moisture 3.4 per cent., vol. matter 22.8 per cent., fixed carbon 58.8 per cent.; and ash 15.0 per cent.; similarly, ash showed moisture .20 per cent., vol. matter 1.0 per cent., fixed carbon 18.9 per cent., and ash 79.9 per cent.

The energy distribution of the coal burnt was as follows:—To water 80.6 per cent., to chimney gases 8.35 per cent., unburnt fuel 5.0 per cent., radiation and unaccounted for 5.05 per cent. The average evaporation was 7.21 per lb. (actual), but during the last five hours 7.40 lb. per lb. (actual); resulting efficiency 82.8 per cent.

The power taken to produce the draught was 60 H.P.—at 11 lb. per H.P.-hour, draught production took 1.52 per cent. of the steam generated.

The commercial test figures on a bank of four boilers, at Vereeniging, which were isolated from the other plant and supplied steam to a 12,000-KW. turbine, its turbine-driven auxiliaries and one steam turbine-driven feed pump, are shown in Table II.

The coal was crushed slack (0-½), of an energy value of 2.88 KW.-hours/lb.

A further test was made at Vereeniging on 18 steaming boilers, nine burning crushed slack and nine burning large crushed and nuts. An excessive amount of dust was present, due to a defect in the crusher, and the efficiency of the boilers burning slack fell from 75 to 67.7 per cent.

The most important factor affecting efficiency is the different character, energy value, and size of the coal burnt. The tendency is for duff coal, which constitutes the great bulk of the coal burnt, to contain more and more absolute dust, which clogs up the fire or falls between the links of the grate. Such coals must be mixed with other coals for efficient burning, and care is taken that this is done in the conveyor from the outside to the overhead bunker.

It is general knowledge that duff coal burns better when wetted; unless wet it goes over the grate like a blanket, and at a low furnace temperature, and increasing the draught breaks up the fuel bed into ridges, letting in excess coal air and lowering the efficiency.

Burning dry duff alone about 6 per cent. CO_2 only is obtained, but if wetted 10.5-12 per cent.

By experience, it is found that it pays to wet all coals, whether mixed or duff, except only clean peas and nuts, but the wetting has to be uniform, and the most successful

scheme has been to spray the coal as it leaves the overhead bunkers and enters the chute to the stoker hopper, though this can only be done when the feed is constant, as alteration results in too wet or too dry coal.

TABLE II.—Commercial Test on a Bank of Four Boilers, Babcock & Wilcox Marine Type, Vereeniging. (Slack Coal Test.)

1. Period of test	96 hours.
2. Boiler heating surface	5,920 sq. ft.
3. Superheater heating surface	2,247 „
4. Economiser heating surface...	2,290 „
5. Grate area	252 „
6. Energy value of coal burnt (slack) ...	2·88 kw.-hr./lb.
7. Total coal burnt	1,259 tons.
8. Coal burnt per sq. ft. grate	28·5 lb./hr.
9. Average evaporation per boiler per hour ...	38,100 lb. actual.
10. Average evaporation per lb. of coal ...	5·80 lb.
11. Average evaporation per sq. ft. of boiler heating surface	5·96 lb.
12. Average steam pressure at turbine stop valve	181 lb./sq. in.
13. Average steam temperature at turbine stop valve	354° C.
14. Boiler house efficiency	75 per cent.*

* This includes pressure and temperature losses up to the turbine stop valve. The actual boiler efficiency is slightly higher than the figure given.

Too wet coal is liable to stick in buckets, bunkers, chutes, &c.

At the Brakpan plant, owing to not being able to mix the various coals, a low-grade fuel ((2.25 kw.-hr.-lb.—32-36 per cent. ash) has to be burnt alone in the new boiler-house, but though the boiler-house efficiency has fallen off, the economy has improved.

The low-value coal referred to—2.25 kw.-hr.-lb.—containing 32.5 per cent. ash, is so near the limit of what can be burnt commercially on chain-grate stokers that a slight variation downwards in value causes serious loss in efficiency, and it is often necessary to relight fires with higher value coal and reheat the arch before a fire can be got going again. The principal factors in burning such low grade fuels are: (1) Arch design, (2) grading, (3) draught, (4) saturation of duff or slack with water.

TABLE III.—Boiler-house Efficiencies, Load Factors, &c.

	1914.	1915.	1916 (4 months)
Brakpan.			
Units sent out	36,324,000	116,725,000	42,185,000
Boiler-house efficiency ...	76·2 %	72·7 %	71·2 %
Rosherville.			
U.S.O.	253,650,000	203,800,000	67,430,000
Load factor	40·2 %	34·3 %	33·7 %
Boiler-house efficiency ...	73·2 %	73·5 %	74·6 %
Simmerpan.			
U.S.O.	118,800,000	152,700,000	53,600,000
Load factor	39·8 %	48·6 %	52·5 %
Boiler-house efficiency ...	73·3 %	76·4 %	76·1 %
Vereeniging.			
U.S.O.	229,600,000	269,400,000	86,050,000
Load factor	59 %	67·4 %	66·5 %
Boiler-house efficiency ...	70 %	72·1 %	74·8 %

Boiler-house efficiency includes pressure and temperature losses up to turbine stop valve.

The arches standardised for conditions at Brakpan are shown in fig. 5; they are 10 ft. 8 in. long, as against the standard arch of 8 ft., and stand a furnace temperature of 1,200-1,300 deg. C. with low-value coal, but have a relatively short life with higher temperatures. The conditions giving the best results with low-value coals are:—

	Peas (½ in. — ¾ in.).	Slack (0 in. — ½ in.).
Fire thickness	6 in.	4½ in. — 5 in.
Grate speed	No. 3	No. 4
Draught at uptake ...	1·2 in. — 1·3 in.	1·7 in. — 1·8 in.
Draught over fire	·50 in.	·50 in
Coal burnt per sq. ft. per hr.	32 lb.	35 lb.

The conditions have to be maintained steadily, and load variations met on those boilers burning better coal. The coal is now graded into the two sizes shown. The boiler-house efficiency at Brakpan is about 72.5 per cent., and will probably increase to 74.5 per cent.

While at Brakpan the problem is to burn low-grade fuels, at Simmerpan and Rosherville the difficulty is obtaining high boiler-house efficiency with the relatively low load factors at which the stations run.

At Rosherville, the load factor is 30-40 per cent.; 28 boilers are required for the day load, and only six at night, and efficiency suffers from having to keep so many boilers alight without doing any work. Fig. 7 shows the load curve. The coal burnt in banked boilers is over 3 per cent. of the total coal burnt; in addition, the average evaporation is only about 70 per cent. of the rated capacity of the boiler, due to the time taken to bring the boiler up to full capacity and for it to die down. The station operates under set conditions, and men are trained to a stereotyped set of operations. Mixed coal and duff are burnt, having energy values between 3.36 and 3.46 kw.-hr.-lb.

The Simmerpan station takes up the large load variations as shown by the

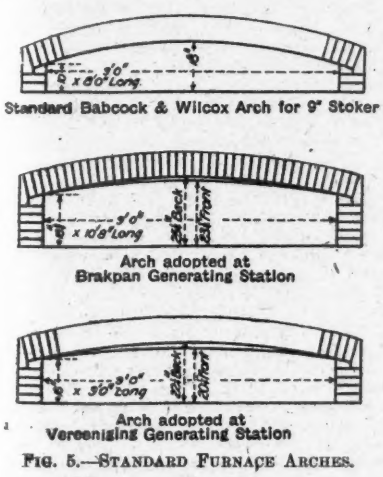
9'0" x 6'0" Long
Standard Babcock & Wilcox Arch for 9' Stoker
9'0" x 10'8" Long
Arch adopted at Brakpan Generating Station
9'0" x 9'0" Long
Arch adopted at Vereeniging Generating Station

Fig. 5.—Standard Furnace Arches.

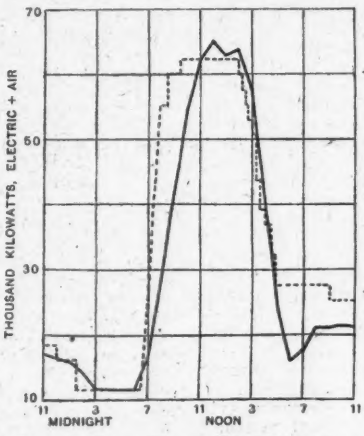

Fig. 7.—Load Curve, Rosherville; dotted line for boilers steaming.

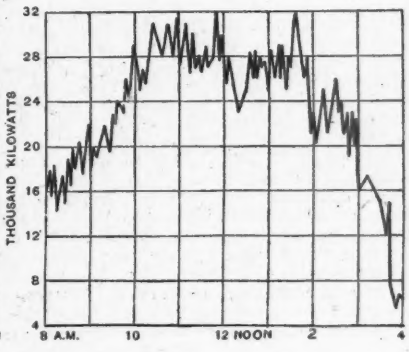

Fig. 8.—Load Curve, Simmerpan Station.

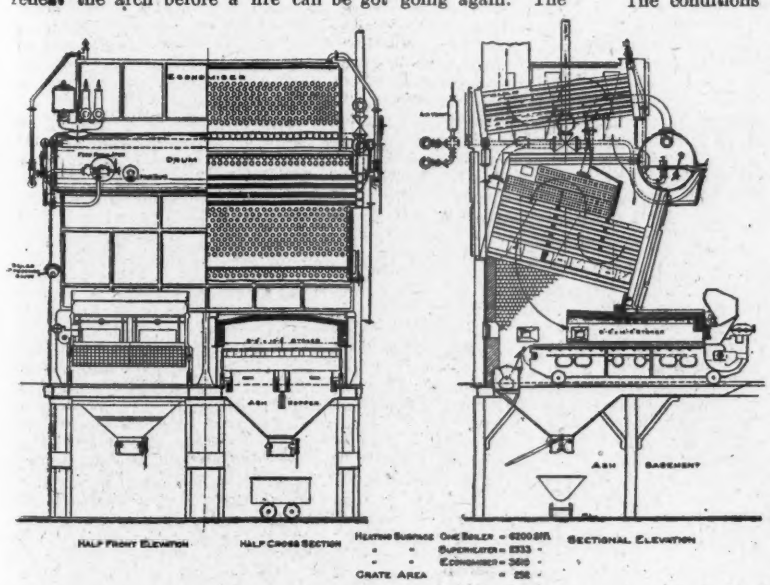

Fig. 6.—Self-contained Boiler Unit.

load curve fig. 8. The switchboard staff communicate direct with the boiler-house staff by signal indicating rising or falling load.

At Vereeniging station the small by-product coal was insufficient in quantity, and a crusher was installed; the combination of low grade and the large size and wide grading was a difficult problem.

(To be concluded.)

PRINCIPLES INVOLVED IN COMPUTING THE DEPRECIATION OF PLANT.

The paper by Messrs. F. Gill and W. W. Cook was read and discussed at a meeting of the Manchester Local Section of the Institution of Electrical Engineers on January 16th.

Mr. S. L. Pearce (chief engineer and manager, Manchester) said members generally would agree with the definition of the respective functions of the engineer, accountant, and financier, and with the emphasis laid upon the need for the closest co-operation. Within the last few years there had been examples of such co-operation in connection with electricity undertakings in this country; for instance, at Bristol between Sir Wm. Preece and Prof. Dicksee, and recently at Southampton, where Sir John Snell was associated with an eminent accountant. When all had been said on this point, it remained true that the engineer had to bear the brunt of the correctness or otherwise of the depreciation charges, because it devolved upon him at the start to estimate the factors which determined it, namely, the first cost and the lives of various portions of plant. After making clear what was meant by "depreciation," the authors resolved it into two components, renewals and improvements. The first of these was provided for already in the case of local authorities, who were compelled by statute to form a sinking fund in connection with electricity undertakings; but everyone did not appear alive to the necessity of making provision against the possibility of having to scrap portions of the plant before the physical life was at an end. It was desirable to emphasise that depreciation was as much a working charge as fuel, and it had to be settled on a well-defined basis, not dependent upon the amount which a company desired to pay in dividends or a local authority to allocate to the relief of rates. Contrary to the authors' opinion, there appeared to be a fair measure of agreement amongst engineers with regard to the question of the life of plant, upon which, of course, the renewals chiefly depended; but the trouble lay in the fact that the recommendations and opinions of experts were very often ignored. The question of obsolescence or improvement introduced the realm of speculation, and there was a divergence of opinion as to the percentage allowance for residual values. It was almost impossible at the present time to forecast correctly future progress, or when the scrapping policy would become desirable; therefore, whilst agreeing with the authors' method from a strictly logical and scientific point of view, it was doubtful whether in practice two sets of elaborate calculations were necessary. One would appear reasonably to satisfy all practical requirements if based on the life of plant, either physical or economic. If the former basis were adopted it would be prudent to build up a general reserve fund to a substantial amount, which, of course, would depend entirely upon local conditions, in order to provide for the possibility of having to scrap a portion of the plant before the physical life came to an end. Regarding the Local Government Board practice in granting loans, 10 or 12 years ago it was usual to allow long periods for repayment, periods which were undoubtedly in excess of the economic lives of portions of the plant, if not in excess of the physical lives. Since 1906, the Board seemed to have leaned to the other side, and the periods were unduly short. It was not clear whether the Board now intended to cover both physical and economic lives; indeed, it was open to doubt whether the new policy was based upon any definite ideas at all. The bulk of the paper dealt with the question of sinking-fund method against straight-line method. The former was adopted by municipalities, and a very strong case was made out in its favour. The choice between the methods became more important when making a valuation of plant. The authors laid undue stress upon the difficulties of carrying out the modernisation of existing plant. Many at the present time were compelled to adopt a big scrapping policy, schemes were being held up, and engineers had to modernise existing stations so as to increase outputs, and difficulties arose when no provision had been made for an improvement fund. The difficulties were not to be exaggerated, as the practice of local authorities was well established. The Local Government Board would grant borrowing powers corresponding to the full value of the new plant required, less the amount outstanding on the old plant. During the period the old plant had still to run, the undertaking carried a double burden, the annual charge on the old plant and the annual charge on the new plant. Obviously, every engineer deciding upon the policy of scrapping a certain amount of plant would have to take all these facts into consideration. It was to be borne in mind that the cost of reproducing plant was not necessarily the same as the original cost. The authors were right in making a strong point of the fact that the life of plant should be reckoned by the work done, and not merely as a number of years. In many electrical undertakings the load factor was going up, and likely to increase still further in the future, and that was to be taken into account in estimating the economic life of the plant. He did not agree that the maintenance costs might be considered not to increase with age of plant. There was no reference in the paper to the provision, in addition to the fund for expiring capital outlay, of a further fund for the acquisition of new plant without recourse to the raising of new capital, commonly known as the double provision basis. Presumably the authors disagreed with such a policy. Regarding those electrical undertakings compelled to contribute to certain sums annually by way of relief of rates, he held that in the event of this policy being abolished the whole of the benefit accruing therefrom should not go to the consumer. The aim of all undertakings should be self-capitalisation spread over a cycle of, say, 40 or 50 years.

Mr. J. Beckett (borough treasurer, Accrington), representing the Lancashire and Cheshire Branch of the Institute of Municipal Treasurers and Accountants, gave examples which proved the scope for a wide divergence of opinion on the question of depreciation. In addition to individual differences of opinion, there was in practice always some oscillation between physical necessity and financial expediency, between actual present needs and available means. The measure of rate aid should not be the answer to the question how much the undertaking would produce. That policy would clearly handicap an undertaking in competition with other forms of light and power, and the solution was a fixed basis of contribution to rate funds. Referring to exhausted plant, the authors suggested that the cost of making changes should be part of the annual charges, but he submitted that it was no part of the annual charges in respect of plant. It might be prudent to make provision for it by way of reserve if there was surplus revenue available for that purpose, but it was certainly not true accounting to charge against the plant for any period more than had been taken out of the plant within that period in earning the revenue. The true principle appeared to be that plant might be discarded and replaced by more economical plant out of capital when the result of so doing upon the revenue account was not only to maintain a state of equilibrium, but resulted in a positive financial advantage to the undertaking. When scrapping plant, the question for the engineer to consider was whether the economies to be effected thereby would compensate for the additional capital charges thrown upon the undertaking, and until that point was reached no engineer would be likely to recommend a change to new plant, or a renewal or improvement of the old. Moreover, local authorities could not give effect to the proposal of the authors, for they were restricted to a reserve fund and a surplus revenue of 5 per cent. upon the capital outlay. Depreciation might be defined as: "The charge against revenue of any given period of that proportion of the cost of production during that period which represents the consequent fall in value due to wear and tear of the producing machinery and plant, or the repayment to capital out of the revenue earned during a given period of such proportion of the original outlay as has been absorbed or consumed in earning such revenue." The authors declared that the function of the engineer was to provide the information necessary regarding the plant, such as first cost, residual value, and life. Depreciation as such was not, as the authors said, a financial operation; it was clearly a physical process having no necessary relation to finance. It was, of course, expressed in terms of finance, but an engineer put into a power house for the purpose of determining the depreciation of the plant might well proceed in terms of percentages without any relation to finance whatever. Again, depreciation had no relation whatever to improvements. The fall in value arising from obsolescence, supersession, antiquation, or the introduction of improved machinery could not be dealt with along mathematical lines. These things were distinct from depreciation of fixed capital, and therefore the speaker was directly at issue with the authors' definition. The primary object of depreciation was the preservation of the original capital, and the measure of the annual charge was the amount of capital annually consumed by the production of the year. Contrary to what was repeatedly stated in the paper, depreciation had no relation to the return on capital outlay. Supposing a period of trade depression or losses occurred over several years; surely the depreciation would not be suspended meanwhile? It was a fact that some undertakings made an annual loss and were subsidised by rates. The process went on, profit or no profit, and if the authors had kept that fact in mind it would have saved them the necessity of making calculations in the paper which needlessly took account of the return on capital, because the return on capital had nothing whatever to do with the question of depreciation. The authors stated, "The depreciation fund is not required until the end of the life," and the question was raised as to the placing of the annual amounts meanwhile. If the money was not required in the undertaking, it would earn interest elsewhere. An accumulating depreciation fund with a fixed minimum rate of interest for the accumulating period came very near the solution of the problem submitted. Meanwhile, the fund represented capital, either in a fixed or liquid

state, awaiting its true function of restoration. It was difficult to believe that anyone would defend the straight-line method, for the simple reason that the method extracted from revenue the total amount of capital in the name of depreciation regardless of interest, which properly belonged to the depreciation fund. An accumulating method also provided a flat rate of charge over the whole period of the estimated life, but the fund required and obtained interest earned; the speaker was, therefore, in agreement with the authors on the question of the character of the fund to be employed for depreciation. The purpose of the sinking fund, speaking of municipal accounts, was fundamentally different from that of the depreciation fund. The sinking fund had to provide capital. Granted a municipality obtained a loan of £100,000, and spent £100,000 on plant and machinery, it would acquire nothing, but the sinking fund was called in to acquire capital. Hence, the local authority with a true depreciation fund, plus a sinking fund, carried a double burden, first for the restoration of capital, and second for the acquisition of capital. The use of both would handicap enormously the initiation of any municipal scheme when compared with private concerns. Items of charges against revenue did not include any charge for what the authors defined as improvements. Regarding maintenance and renewals, the frontiers between these were not well defined, and no provision was made in the scheme to meet the cost of this work. In the paper it was assumed that the cost of maintenance was constant each year. With depreciation fixed upon first cost, and maintenance constant, and taken for granted that it would not increase with age, in what part of the scheme was provision made for the items which combined repairs and renewals? In dealing with the subject of average life and equated life, the authors seemed to have been somewhat confused. Quoting from the paper, "There is a great danger if the difference between average and equated lives is not appreciated"; and again, "For a complex plant, use of the average life will result in inadequate provision, because the equated life is always shorter than the average life." How could this be if, as stated in the paper, "the depreciation fund is not required until the end of the life," and, again, "It is clear that an equated life arranged for all the plant provides money for the renewal of every part"? The speaker asked for a further explanation of the difference between equated and average life, as he had always understood them to be interchangeable. The following resolution, passed at a special general meeting of the Incorporated Municipal Electrical Association in 1902, was of much interest:—"That in the opinion of this Association, electricity supply undertakings having to be maintained in a thorough state of efficiency out of revenue, no depreciation or further writing-off of capital is necessary, when the period allowed for repayment of loans is not greater than 30 years, as the equated life of the plant exceeds that period."

Ald. Walker said that there did not appear to be any necessity for two depreciation funds, as proposed by the authors. If it were decided that plant was not to be run for the whole of its physical life, but for a shorter period termed the economic life, the amount set apart for the sinking fund should be something which at the end of such life fulfilled the object for which it was created. The economic life was the period after which it was justifiable to scrap the plant; therefore, in his opinion, it was incorrect to estimate for more than scrap value. In the case of distributing systems, the value of recovered copper ought to be assumed as the same for both periods. Sound as the system appeared, much still depended upon estimates. Plant should not be thrown out simply because its steam consumption was high; obviously the most economical plant in a station was run with the highest load factor, and the uneconomical plant was only brought into use during the period of peak load. Consequently, any gain shown by replacing such plant might be very small, and it was necessary in such cases to consider the actual contribution of the plant to the total output of the station. In connection with the Manchester undertaking, it was interesting to know that the capital expenditure was over £3,000,000, and there was already raised by the sinking-fund method £1,270,000, leaving a loan debt of £1,730,000. The earlier Local Government Board loans were for the whole sum over a fixed period, and for portions of the plant the periods were undoubtedly too long. Mr. Pearce had made a valuation of what he considered to be the true economic lives; buildings were taken at 40 years, plant and machinery at 20 years, mains and services 20 years, motors 10 years, which periods were very much shorter than those fixed on former occasions. It was decided to establish a renewals suspense account and to transfer from revenue account each year the amount which, put into the renewals suspense account, would be sufficient to meet the deficiency in the sinking fund as shown by the calculated shorter life of the plant. The total amount paid into that account had been about £344,000, but certain renewals had been made, and it now stood at £191,000. This was in addition to the reserve fund. The speaker was of the opinion that the later policy of the Local Government Board in fixing very much shorter periods, and dividing up the loans in accordance with the plant on which they were going to be spent, was bringing the sinking fund itself closely approximate to the economic life. The loan for boilers only allowed 17 years, consequently it was unnecessary to make any further provision, as the economic life of the boilers would certainly not be shorter than the repayment period. In proof of this, there were boilers in commission to-day where every penny had been paid off, and which had yet many years of useful life. The speaker favoured sound depreciation, high maintenance charges, and the amount shown as profit as low as possible. The Finance Committee of the Manchester Corporation in October, 1912, in adopting a policy of rate-aid, actually decided that the amount should be calculated on the capital expenditure. A more false principle could not possibly be put forward, because, as already shown, £1,200,000 of the capital borrowed had been repaid, and to a large extent the assets which had represented it had gone out of commission and ceased to earn any revenue. Supposing 1 per cent. was allowed on £3,000,000 capital expenditure, when in fact there was plant valued only at one million; it meant actually charging 3 per cent. against revenue-earning plant belonging to the undertaking. This was one of the things which would have to be fought keenly by accountants and engineers, and by representatives on public bodies. Any amount fixed for rate aid should be upon the outstanding loan debt, and not upon the capital expenditure, otherwise it would become a growing charge which would jeopardise the existence of the station in competition with other suppliers. It had been argued that a municipality ought to pay into its sinking fund the statutory amount, and that, in addition, it ought to create a renewals account which would enable it to have sufficient capital at the expiration of the economic life to replace the plant without further borrowings. This meant that the present generation of users would hand over as an absolutely free gift to the next generation of users a power station free of all cost. This would be grossly unfair if carried out, but such an attempt would defeat itself, because it would mean such high charges for current that consumers would not buy.

The authors will reply in the *Journal* of the I.E.E.

THE RÖNTGEN SOCIETY.

The Optophone.

At the meeting on February 6th, Mr. E. E. Fournier d'Albe, D.Sc., lectured on the properties and applications of selenium. He said that the peculiarity of the light action on selenium could not be due to heat, as had been suggested, and he believed that some kind of ionisation theory would be propounded as a final solution of the whole question. Selenium was actually capable of discovering light too faint to be visible to the eye. He calculated that with the aid of selenium one ought to be able to discover stars three magnitudes lower than those visible in the ordinary way. The usual limit for naked-eye vision was about the sixth magnitude, so that with selenium one ought to be able to obtain the ninth magnitude, and selenium would keep this start over the eye whatever optical contrivances might be used. He had been able to make a star record itself chronographically, and even ring a bell in its passage, which was quite a simple thing to do, considering the very delicate relays now at one's disposal.

Dr. d'Albe then passed on to deal with some applications of selenium. One of its first applications, he said, was to the measurement of light, but the "recovery curve" was a distinct difficulty in selenium photometry. Another proposed application was for automatic shutters in cameras, but while this was possible theoretically, it was doubtful whether the advantages gained outweighed the trouble of introducing relays. Another application was to multiplex telegraphy by means of a sound disk flashing intermittent light upon the selenium, the flashes being at different rates, and picked out at the other end by means of tuning forks; by this means it was possible to analyse 12 different sets of Morse signals sent along the same wire at the same time. Then there was the interesting application of selenium to phototelegraphy, or the transmission of pictures along the wire. Selenium had been displaced in this work, however, by another method, that of swelled gelatine. The fascinating problem of television was one which, he thought, would certainly be solved in the not distant future by means of selenium, and another practical thing was the automatic lighting and extinction of lighthouses and lightbuoys. The lecturer showed a small model lighthouse which he had constructed; the little lamp was automatically extinguished when a large lamp representing the sunrise appeared in its vicinity.

The device in which he was personally most interested was called the optophone, for enabling blind persons to read ordinary type. His experiments on this instrument were made before the war, but the impossibility of getting the Nernst filaments, which had the advantage of giving an intense line of light, caused the experiments to be left in abeyance until recently, when he found that the new half-watt lamp would act equally well. A disk, revolved by a motor and perforated like a siren disk, was illuminated by a lamp behind it, and the image of the line of dots was converged upon an aperture in a slab above which a line of letterpress was slowly moved. The light thus reflected from the type fell upon selenium bridges which were connected by a telephone relay, and sounds corresponding to each letter in turn were sent through the telephone. Whatever the

difference in shape between any two letters, it expressed itself in tone. Thus the letters gave a sound code which the pupil had to learn. The maximum sound was heard when white paper was exposed through the aperture, and the minimum when black paper was exposed, and all that the blind person had to do—a task obviously requiring a great amount of practice—was to familiarise himself with the range of differentiation between these extremes. Dr. d'Albe's demonstration was carried out with large single letters, but he said that by using a focusing device, printed type of ordinary size could be read, and a system of alignment would make it possible for people ultimately to read by ear a column in a newspaper or a page of a book.

Sir James Mackenzie Davidson and Mr. T. Thorne Baker took part in the discussion.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

RUSSIA.—A Decree of the Russian Minister of Finance, dated November 26th/December 9th, prohibits the exportation of various articles, including electrical apparatus of all kinds, accessories and parts; ferro-silicon; salts and acids of chrome, manganese, molybdenum, titanium, tungsten, vanadium, copper, tin, mercury, nickel, lead, and zinc.

SWEDEN.—The exportation of quartz and felspar has been prohibited as from December 20th.

SWITZERLAND.—The Federal Council have decreed the prohibition of exportation of crude, flake, or powdered asbestos as from December 4th.

NICARAGUA.—The Collector-General of Customs has issued a Circular directing that, as from February 1st, bills of lading containing erasures, interlineations, or alterations shall not be accepted at any Custom House in the Republic unless such erasures, &c., have been duly certified by the agent or representative of the steamship company at the port of shipment.

VENEZUELA.—According to recent Presidential Decrees, the undermentioned goods, when imported into Venezuela, are to be declared in the Consular invoice, and to pay duty, as follows:—

Article.	Declaration for Consular invoice.	Class of the tariff under which suitable.	Total import duty (including surtaxes).
Electrical accumulators.	Acumuladores eléctricos.	III.	0·391 bolivares per kilog. gross.
Electric stoves weighing each up to 60 kilogs. net.	Cocinas eléctricas que pesen hasta sesenta kilogramos netos, cada una.	III, plus 80 p.c. specific.	0·704 ditto.
Electric stoves weighing each more than 60 kilogs. net.	Cocinas eléctricas cuyo peso neto exceda de sesenta kilogramos.	III.	0·391 ditto.

It is important to preserve the exact (Spanish) wording shown above in the "Declaration for Consular Invoice." (Bolivar = 9.6d.; kilog. = 2.2046 lb.)

NEW PATENTS APPLIED FOR, 1917.

(NOT YET PUBLISHED).

Published expressly for this journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

1,412. "Electrical governors or speed regulators for electrical motors, &c." S. J. ANDERSON. January 29th.
1,437. "Electrical pushes." E. A. GRAHAM. January 29th.
1,449. "Electrical switch slabs or panels, &c." W. J. JENKINS. January 29th.
1,460. "Wireless telephony." SOC. FRANCAISE RADIO-ELECTRIQUE. January 29th. (France, February 15th, 1916.)
1,465. "Electric warning attachment for ships' telegraphs." J. L. MURPHY. January 30th.
1,478. "Detachable instrument for varying timing of ignition of motor-car automatically." C. L. WHATLEY. January 30th.
1,482. "Dry cells." F. C. TAMMADGE & F. R. TAMMADGE. January 30th.
1,490. "Toy electric motor." A. C. GILBERT CO. January 30th. (U.S.A. April 18th, 1916.)
1,491. "Toy motor installation." A. C. GILBERT CO. January 30th. (U.S.A., April 18th, 1916.)
1,501. "Storing and correcting defective telegraphic signals preparatory to transmission." J. H. DUNBAR & THE EASTERN TELEGRAPH CO. January 30th.
1,511. "Systems of ship propulsion." BRITISH THOMSON-HOUSTON CO. (General Electric Co., U.S.A.). January 30th.
1,514. "Telegraphy." J. S. WITHERS (J. C. Cox). January 30th.
1,515. "Frequency changers and generators of alternating electric current." N. OBOUKHOFF. January 30th.
1,517. "Automatic telephone system." H. SYMES. January 30th. (New Zealand, October 10th, 1916.)
1,525. "Order telegraphs." G. T. MARSLAND. January 30th.
1,544. "Dynamo-electric machines." SOC. ANON. POUR L'ECLAIRAGE ELECTRIQUE DES VEHICULES. January 31st. (France, February 4th, 1916.)
1,546. "Electric thermo-radio massage machine." G. FULLER & J. W. WATKINS. January 31st.
1,555. "Electrolytic production of metal wire and strip." S. O. COWPER-COLES. January 31st.
1,575. "Contact-breakers for ignition mechanism of internal-combustion engines." F. H. FARRER, G. FUNCK & VILLIERS ENGINEERING CO. January 31st.
1,576. "Fly-wheel magneto devices for internal-combustion engines." F. H. FARRER, G. FUNCK & VILLIERS ENGINEERING CO. January 31st.
1,577. "Magneto devices for internal-combustion engines." F. H. FARRER, G. FUNCK & VILLIERS ENGINEERING CO. January 31st.
1,578. "Method of electrical edge-welding." T. E. MURRAY. January 31st. (U.S.A., March 2nd, 1916.)
1,581. "Vacuum-type electric converters." BRITISH WESTINGHOUSE ELECTRIC AND MANUFACTURING CO. (Westinghouse Electric & Manufacturing Co., U.S.A.). January 31st.
1,587. "Polyphase transformers." F. E. BERRY & BRITISH ELECTRIC TRANSFORMER CO. January 31st.
1,588. "Electric furnaces, and transformers for use therewith." F. E. BERRY & BRITISH ELECTRIC TRANSFORMER CO. January 31st.
1,609. "Liquid resistances for use in rotors of induction motors for ship propulsion, &c." BRUSH ELECTRICAL ENGINEERING CO. & C. C. SUTTON. February 1st.
1,612. "Sparking plugs." A. E. TONKS, E. TONKS & SONS, C. W. TONKS, E. TONKS & G. A. TONKS. February 1st.
1,629. "Ignition magnetos for internal-combustion engines." M-L MAGNETO SYNDICATE & E. A. WATSON. February 1st.
1,636. "Electrolytic production of metallic tubes with closed end." S. O. COWPER-COLES. February 1st.
1,641. "Electro-magnetic switches." BRITISH THOMSON-HOUSTON CO. (General Electric Co., U.S.A.). February 1st.
1,653. "Electric transmission of signals." E. A. LAIDLAW. February 1st.
1,661. "Electric furnaces." C. E. HEARSON. February 1st.
1,670. "Automatic ignition for internal-combustion engines, &c." F. A. SAXELBY. February 2nd.
1,674. "Electric furnaces for melting or refining non-ferrous alloys." V. C. FAULKNER. February 2nd.
1,678. "Portable electric hand-lamps, &c." N. MCLEAN. February 2nd.
1,687. "Lighting outfit for road vehicles." G. BOOTHWELL. February 2nd.
1,692. "Magnetic compasses." C. F. RYLAND. February 2nd.
1,712. "Apparatus for producing sound waves for signalling." W. V. FOULIS. February 2nd.
1,713. "Electrical measuring instruments." J. H. CARE. February 2nd.
1,729. "Wiring ships, buildings, &c., for distribution of electricity." L. M. WATERHOUSE. February 3rd.
1,732. "Process for manufacture of zinc tubes." S. O. COWPER-COLES. February 3rd.
1,739. "Flexible-cable funicular traction system." COMPAGNIE GENERALE ELECTRIQUE. February 3rd. (France, February 7th, 1916.)
1,748. "Electric bells." J. DAVIS & SON AND W. H. DAVIS. February 3rd.
1,754. "Electric motor control and apparatus therefor." BRITISH THOMSON-HOUSTON CO. & H. C. HASTINGS. February 3rd.
1,762. "Stimulating growth of hair by weak currents of electricity." A. C. STEWART. February 3rd.
1,764. "Dynamo-electric machines." P. A. H. MOSSAY. February 3rd.

PUBLISHED SPECIFICATIONS.

1915.

5,319. PROCESS OF AND APPARATUS FOR TESTING ELECTRICITY METERS. S. T. Blathy. April 8th. (April 9th, 1914.)
10,722. ELECTRICAL HEATING APPARATUS. C. G. Nobbs & W. W. Hobbs. July 23rd. (January 21st, 1916.)
17,581. AUTOMATIC TELEPHONE CALL DISTRIBUTING SYSTEMS. Western Electric Co. December 16th. (December 19th, 1914.)

1916.

The numbers in brackets are those under which the specification will be printed and abridged, and all subsequent proceedings will be taken.

471. ELECTRICAL CONDENSERS. Marconi's Wireless Telegraph Co. & C. S. Franklin. January 11th, 1916. [102,997.]
477. IGNITION DEVICES FOR INTERNAL-COMBUSTION ENGINES. M. A. Cadd. January 11th. [102,998.]
487. MAGNET SYSTEMS FOR MAGNETO-ELECTRIC MACHINES FOR IGNITION PURPOSES IN INTERNAL-COMBUSTION ENGINES. W. Schmidt. January 11th, 1916. [100,018.] Convention date not granted.
519. SECONDARY BATTERIES. G. Pearson. January 12th, 1916. [100,999.]
541. IGNITION DYNAMOS. C. T. Mason. January 25th, 1915. [100,001.]
579. STARTING OF SYNCHRONOUS DYNAMO-ELECTRIC MACHINERY, AND MEANS THEREFOR. J. Mould. January 13th, 1916. [101,809.]
581. ELECTRICAL APPARATUS FOR PRODUCING HOT AND COLD CURRENTS OF AIR FOR DRYING HAIR AND FOR OTHER PURPOSES. E. B. Wright. January 13th, 1916. [103,153.]
599. RADIO RECEIVING CIRCUITS. C. F. Elwell & C. J. Close. January 13th, 1916. [103,004.]
676. AUTOMATIC STEERING AND SELF-PROPELLED TORPEDOES AND OTHER PROJECTILES. V. Pascore, C. J. Beaver & E. A. Claremont. January 16th, 1916. [103,007.]
721. ELECTRO-MAGNETIC SHUTTLE-THROWING GEAR FOR WEAVING LOOMS. Bachelet Shuttle & Loom Co. and W. Routledge. January 17th, 1916. [103,157.]
802. ELECTRIC SWITCHES. British Thomson-Houston Co. (General Electric Co., U.S.A.). January 18th, 1916. [103,167.]
876. TELEPHONE SYSTEMS. Relay Automatic Telephone Co. & L. C. Bygrave. January 19th, 1916. [103,173.]
999. SPARKING PLUGS AND THE MANUFACTURE OF THE SAME. T. Crosbee and Sons & W. J. Spicer. January 21st, 1916. [103,179.] (Addition to 4,999/15.)
1,417. CORES FOR PUPIN LOADING COILS, ELECTROMAGNETS, AND THE LIKE. Western Electric Co. (Western Electric Co., U.S.A.). January 29th, 1916 [103,188.]
1,976. ELECTRIC DIAPHRAGM HORNS FOR AUTOMOBILES AND THE LIKE. A. W. Hulbert. July 25th, 1916. [103,018.]
2,065. RADIO-TELEGRAPHY. J. Bethenod & E. Girardeau. February 11th, 1915. [100,075.] (Addition to 1,597/16.)
2,076. MAGNETIC COMPASSES. F. Barker & Son and E. W. Barker. February 11th, 1916. [103,019.]
2,256. ELECTRIC BATTERIES. R. S. Baxter. February 15th, 1916. [100,000.]
2,916. RAILWAY SIGNALLING. W. R. Sykes Interlocking Signal Co. & R. W. Tarrant. February 26th, 1916. [103,026.]
3,161. BATTERY CELLS. W. L. Walker. March 17th, 1915. [100,176.]
3,266. ELECTRIC CABLE DRUMS, REELS, OR THE LIKE. H. G. Wood & E. Edwards. March 4th, 1916. [103,206.]
4,192. SPARKING PLUGS FOR INTERNAL-COMBUSTION ENGINES. R. A. Griffiths and W. P. Gilbart. March 21st, 1916. [103,044.]
4,558. ELECTRIC DISCHARGE APPARATUS. British Thomson-Houston Co. (General Electric Co., U.S.A.). March 28th, 1916. [103,046.]
4,697. ELECTRIC OSCILLATORS. British Thomson-Houston Co. (General Electric Co., U.S.A.). March 30th, 1916. [103,047.]
5,257. SPARKING PLUGS FOR INTERNAL-COMBUSTION ENGINES. A. B. Buck. April 11th, 1916. [103,051.]
5,422. PORTABLE MILITARY TELEPHONES. J. W. Dungey & C. B. Kersting. April 13th, 1916. [103,227.]
5,934. ELECTRIC LOCOMOTIVES. British Thomson-Houston Co. (General Electric Co., U.S.A.) April 25th, 1916. [103,235.]
5,972. POINTS FOR TRAMWAYS, RAILWAYS, AND THE LIKE PURPOSES. R. B. Holt. April 26th, 1916. [103,236.]
6,355. TELEGRAPHIC TRANSMITTERS AND RELAYS. Orling's Telegraph Instruments Syndicate & A. Orling. May 3rd, 1916. [103,238.]
6,618. LOCATION INDICATORS FOR ELECTRIC PRESS-BUTTONS. E. D. A. Bugot May 9th, 1916. [103,059.]